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Commissions and Maximum Rates

LAST SUMMER, in the issue of Aug. 7, page 154, this journal had occasion to comment on the decision of the New York Public Service Commission, Second District, in the Ulster & Delaware case. Although the carefully prepared report of W. J. Wilgus, consulting engineer, had convinced the commissioners that the existing passenger rates of this railroad were unremunerative, they ruled by a vote of three to two that the statutes did not empower them to raise the rates, the existing rates being the maxima fixed by the railroad law. The Engineering Record predicted that if the case was carried to the Court of Appeals the authority of the commission to set aside the maxima of the statutes would be upheld. And the prediction has just been made good by a finding of the Appellate Division of the state Supreme Court. Without going into the details, the ruling decision states in substance that the amendments of 1911, subsequent to the passage of the public-service and railroad laws, would be meaningless if the commission's interpretation were correct, and that the legislative maxima were intended to prevail only in the absence of action by the commission. The decision is an encouraging indication that a single official body may, after all, handle the whole rate question, and regulate rates either upward or downward as justice demands.

The Ultimate Court

IT is significant that in the great labor controversies which seem imminent—those on Western railroad systems and in the anthracite mining field—both sides to the controversies are making their efforts to get their case before the ultimate court—the public at large. The time was when the weaker party to such a controversy sulked in the background and contented himself with declaring that the other fellow was unreasonable and unjust. Now both sides are in the open, though, as is to be expected, each dresses up his argument in his own defense with all the ingenuity possible. If the public will read both sides with discrimination serious conflict in these fields may be avoided, for the mere fact that most employers and employees are endeavoring to get their views before the public is an admission that they do not expect to run counter to what the public will ultimately decide is the correct view of the matter. The anthracite mine operators have started this publicity campaign by using full-page advertisements in the newspapers, while the miners have distributed to the press a 250-page book giving their side of the case. In the West the newspapers have been plentifully supplied with the arguments of both the railroads and the engine and train men. If the controversy is thus fought out in the press, the more serious conflict—an actual stoppage of work, with all of the suffering and loss entailed—may be avoided. It is earnestly to be hoped that such will be the case. It is fairly easy to predict that, at the least, since both parties are endeavoring to argue with the public, that they will not be able to resist the demand which is sure to come from the public for arbitration.

Grasping the Fundamentals Correctly

NO progress can be made in the consideration of any question if the very fundamentals are misunderstood. Such seems to be the case in connection with the demands which the Western engine men and train men are making on the railroads. The controversy is briefly alluded to in the preceding note. The public generally, and the newspapers also, believe that the railroad employees are demanding an eight-hour working day. This is not the case. What they are demanding is an eight-hour day basis of payment. In a word, they ask for the same pay for eight hours as is now given them for ten hours, an increase of 25 per cent without increasing the amount of work delivered therefor. The demands do not require the reduction of the working time of the employees. Manifestly this is not necessarily the deciding point in that controversy, but immediately it puts the question squarely before the public whether or not the employees are entitled to a 25 per cent increase. Various angles need consideration and will not be taken up here. One thought, however, will come at once to the mind of every engineer who has followed rate regulation in recent years: Even if these demands, on the sole ground of economic consideration involving the employees alone, ought to be granted could the railroads in their present condition, without additional revenues from passenger and freight service, stand the increased strain?

Intensive Street Cleaning

DROP pieces of paper on the street in the shopping district in Chicago and they will be picked up, on the average, inside of 2.7 min.; every piece will be removed within 15 min. This is the yardstick in the new standard of street cleanliness, discussed on page 252. The sweeper cleans up his "block" or "patrol" during the first hour of the morning and thereafter transfers his daily burden from his arms to his legs, for he must walk rapidly from one end to the other, ever alert to make his pickups as fast as they fall. He must keep abreast of his work. Few shop-keepers in Chicago realize the high standard which has been set—one that requires the cleaner to pass their doors from sixty to ninety times every day. These remarks refer to the large refuse. The fine residual dust problem is not so easy to handle, particularly on cold days in winter when sprinkling is impracticable. The vacuum cleaner immediately comes to mind, but it will be necessary to make one small enough to dodge in and around traffic and over the sidewalks. Such a machine, operated by one man, would find instant consideration. Another possible solution is to sweep over the street an oiled sawdust or some material carrying an antiseptic chemical which would immediately fix the dust by contact. Both schemes appear to be too expensive, but experimental work with them may lead to a solution. Certain it is that the Citizens' Street Cleaning Bureau, now that its standards have been raised so high, will not hesitate to experiment fully and to put into effect any plan that promises to abate this dust nuisance on the few cold days in the year.

Bone Patent Declared Invalid

ALTHOUGH Judge Anderson, of the United States District Court of Indiana, in his decision against the validity of the Bone patent for reinforced cantilever retaining walls, frankly declared that he expected the plaintiff to appeal on the ground that "the defeated party usually thinks that the trial court knows nothing about it, and that he will go to a court that does understand it," the new evidence presented by Professor Hatt showing prior application of the fundamental idea is convincing. It is surprising, in view of the arguments of Judge Anderson, which are abstracted on page 243 of this issue, that courts have previously upheld the Bone patent. While engineers have assumed that the fundamental principle involved in placing steel rods to resist tension in such walls could not be patentable, the fact remains that the Bone patent for a steel frame reinforcement in cantilever walls was actually issued in 1902. Innumerable suits by Mr. Bone for alleged infringement have resulted. In spite of the fact that the evidence of prior art introduced by Professor Hatt has, of course, been in existence all the time, previous cases were decided in favor of the plaintiff, apparently ignoring these facts entirely. Assuming that the essential requirement for patentability is the proof that the device is new and based upon a new idea, the existence of prior designs or prior art based upon the same idea, as shown in the new evidence introduced in this case, certainly raises the question whether the lawyer-controlled system of judging the validity of engineering patents is not inherently weak, to say nothing of the apparent mistakes in the United States Patent Office itself in the issuance of patents, due to a lax system of investigation. Many engineers consider any new developments in engineering design which they may devise to be the rightful possession of the whole engineering profession. Take, for example, the New Halifax quay wall design described in last week's issue. This is undoubtedly patentable, yet the engineers have made no effort to reserve to their own private profit the benefits of the new idea.

Engineers Mobilize in Force for First Military Lecture

MORE than a thousand men filling the auditorium of the Engineering Societies Building, six hundred more in an overflow meeting on the fifth floor, and hundreds of others unable to gain admission to either hall because of Fire Department rules—this is the way the engineering profession of New York mobilized to greet Captains Thomas M. Robins and Richard T. Coiner of the United States Army Engineer Corps at the opening session on Monday of the military lecture course for New York engineers, organized by the four national engineering societies. If any concrete evidence were needed to prove that the technical man realizes his responsibility in National Defense, it was supplied in full measure at the meeting this week. From the enthusiastic response one inference seems clear—the War Department can count upon a plentiful supply of raw material from which to recruit its engineer troops if an enlargement of this branch of the service ever becomes necessary. This is worth knowing, for the progress of the war in Europe has demonstrated that engineers are needed as they were never needed before to insure the success of great offensive and defensive movements. The engineer's art is the backbone of war as it is waged to-day.

Captain Robins, in his initial address, which is reported in the news section of this issue, attempted to give nothing more than a birdseye view of the organization and duties of engineers in war, and to explain in a general way what engineers in civil life will be called upon to do in the defense of the United States, but he left in the minds of his engineer audience this vital thought: No matter how proficient the engineer may be in civil practice, he is of little use at the front unless he is thoroughly grounded in the duties of a soldier. Engineer troops must fight and defend themselves, as well as erect and demolish structures. There is no royal road to military training. It means hard work—not in a library armchair with a printed manual of instructions, but out in the open, in camp and on the march. Of course, reading and study are necessary, but it is time now to dispel any illusions which may lead an engineer to think that he can step from his office into command of engineer troops at the front and direct them successfully. It can't be done.

A man must know close and extended order drill, the manual of arms, the use of a rifle, and have inculcated in him by intensive training the fundamentals of military discipline and team-work before he is fit for active duty. This groundwork in first principles can be obtained only through service in the regular Army, the National Guard or at summer camps, such as the one at Plattsburg last year. The committee which organized the lectures realizes this need for supplementing the oral instruction by a tour of field service, and it is safe to assume that an engineer battalion will be formed at Plattsburg next summer. Every engineer who intends to make himself of real use, in a military sense, should plan to attend camp.

All of the engineer's work in war, however, is not with the advance troops. What has been said applies particularly to operations with the combatant forces, and is directed principally to the men not too old to stand vigorous work in the field. There are, in addition, the important services on lines of communication and defense. Here the older men can be used to advantage—in directing railway operation, the manufacture of munitions, coast defenses, etc. Their mature judgment will be invaluable to the War Department in doing the kind of work needed to support the fighting troops of younger men at the front, but their military training need not be so comprehensive as that of the man who will operate in the fighting zone.

It is clear from Captain Robins' remarks that there is a place for almost every man with technical training—young or old. After the lectures are finished on March 27, the next step is to carry the enthusiasm which characterized them into camp, so that the theories expounded indoors may be put into practice in the field.

Safety in Dam Design

THE recent destructive floods in southern California have taught the usual lessons. The disastrous failure of the Lower Otay dam, described fully in last week's issue, proved again, if proof were needed, the unwisdom of accumulating in a structure of such magnitude and importance so many elements of uncertainty. The question of how far it is proper to go in providing against unprecedented conditions is one of such complexity that anything like complete agreement among engineers is hardly to be expected. Yet this question presses for some kind of an answer. It is plain that the flood hazards to be guarded against in the semi-arid Southwest have been underestimated heretofore, and there is little doubt that in future much more generous provision will be made for securing safety. But it is also essential that the wisdom of solid and permanent construction be recognized by a marked avoidance of cheap or questionable design or construction materials. This does not mean a stupid prodigality, but a more thoughtful regard for recent developments in dam design, as well as a wholesome respect for the unexpected.

One of the most valuable lessons to be learned from the disasters and narrow escapes of the last flood period in California is the high value of the arch as an element in the design of masonry dams. The slender Upper Otay dam was overtopped by a flood pouring 3 ft. deep over its crest. Slender as are its proportions, and extreme as were the compressive stresses to which it was subjected, the dam was wholly uninjured. The old Bear Valley dam—a thin, arched structure that withstood the vicissitudes of flood and ice for many years without sign of weakness—can hardly be accused of representing conservative design, and the Sweetwater dam, handicapped by a central portion acting as a cantilever, stood without serious damage an overpour that would certainly have carried away the hollow shell recently added to its height had the structure been straight instead of arched. The flood of 1895 proved that the original spillway of the Sweetwater dam was wholly inadequate—a fact recognized in subsequent improvements by the provision of a spillway having an estimated capacity of 5500 sec.-ft. Yet it is estimated that during the peak of the recent flood six times this amount passed through the spillway, over the crest of the dam, and through the break in the earthern embankment at the north end of the main structure.

It may be said that if safety be granted as an essential in the design and construction of a dam, it must conform to one of two general types. The first is of such design and constructed of such materials as to sustain without danger a heavy overpour for a considerable period if the spillway capacity is exceeded. This is certainly the safest general type. The second, which may include all kinds of earth embankments, hydraulic-fill, and rock-fill dams—in short, dams constructed of any material subject to serious damage from overtopping—must have a spillway capacity in excess of the full peak of any flood that the most liberal estimates can indicate as remotely possible, and, what is still more important, the passage to this spillway must be kept absolutely unobstructed. It must be remembered that the peak of the flood may come on a full reservoir, as was the case with the recent flood when it reached the Sweetwater reservoir. It would appear, then, that if the requirements of safety are to be met by the provision of this extraordinary spillway capacity as a vital accessory to the second general type of dam, the first and generally preferable type in many cases may actually be lower in first cost.

The Lower Otay dam was a hybrid structure. Work was started with the intention of building a concrete dam, and after a ten-year construction period without adequate engineering supervision the finished product was not in accord with the rules of good practice. Well-known engineers criticised the manner of preparing the foundation, the design of the section, and the material used in the fill. However, the dam failed when overtopped, and after noting other features of this remarkable structure it is not surprising to find that, although the drainage area comprised 100 sq. miles the spillway provided was only 38 ft. wide with its lip but 3 ft. lower than the concrete core of the dam. The unfortunate feature is that the failure of such a structure creates in the public mind distrust of safe structures. In addition to the public supervision and inspection of dam construction which is usually demanded as a sequel to such disasters, the still greater need is for sound engineering practice in dam design.

What Is the New Evidence?

IN two previous editorial discussions of the proposal to move the headquarters of the American Society of Civil Engineers to the Engineering Societies Building, the Engineering Record has pointed out that the resubmission of the proposal of thirteen years ago is in itself evidence that there are new factors in the case, that the conditions have so changed that the plan of a unified headquarters deserves full consideration anew.

What is the new evidence? How have the conditions changed? What are the new elements that were not present thirteen years ago?

Brief reference to the earlier discussion of the question, when the proposal to join with the other societies was defeated by a vote of two to one, shows that the arguments against moving were, briefly, as follows:

1. That the three other national societies were weak financially and might be unable to carry their share of the financial responsibility of the undertaking.
2. That close relations with societies that had lower standards than the civil engineers would result in lowering the society in the estimation of the public and of the profession.
3. That a "merger" with the other societies was intended.
4. That the American Society of Civil Engineers would lose its identity and dignity.
5. That housing in a building adjacent to the Engineers' Club, a social organization, would work harm.

There is no reason for discussing now whether these contentions thirteen years ago were true as to fact and justifiable as to conjecture. On the contrary, for the sake of agreement at the inception of discussion, it may be admitted that the alleged facts were true and the fears reasonable. The important question now is: Do these facts hold to-day, and is there still reason to fear the undesirable results predicted thirteen years ago?

We stand to-day in a far better position to pass judgment on the proposal than did the membership thirteen years ago. Then there was no experience as to the joint operation by engineering societies of a $1,500,000 investment; then there had been no test of the ability of the other societies to shoulder and work off a heavy financial burden; then there were no data on the effect upon the societies themselves of close co-operation with bodies bearing different standards, and no way to judge of the effect which such close co-operation might have on the standing of the individual societies before the public and the profession. Now there is ten years of experience. What do the facts, as they are to-day, and the ten years of experience show?

In the first place, each of the three other societies—of mechanical, electrical and mining engineers—will soon have successfully worked off the debt, about $240,000, which it assumed when the new building was erected. The United Engineering Society, the body which holds and operates the building for the three founder societies, is out of debt and has a reserve fund of $70,000 toward amortization and for repairs. The fear, therefore, that the mechanical, electrical and mining engineers cannot carry the financial responsibility of the Engineering Societies Building can no longer be entertained. It is true that these societies are not as strong financially as is the American Society of Civil Engineers. They are, however, on a sound financial basis, and with their big obligation—that involving their respective shares of the property cost—practically wiped out, the growth in financial strength will be rapid.

The second objection listed above refers to the lower standards of the other societies. To learn whether that objection is still valid attention is directed to the article on page 245 of this issue, which shows the requirements for admission and the membership curves of the four national societies. It is evident that in the highest grade the requirements of the mechanical and electrical engineers are now on a par with, or higher than, those of the civil engineers. The mechanical engineers' age limit is two years higher than that of the civil engineers; the professional requirements are the same. The electrical engineers likewise require a higher age, but two years less in responsible charge of work. The mining engineers, admittedly, have not advanced their standards as have the other societies. The objection of lower standards, then, has been removed in large part—provided that the requirements are rigidly adhered to. Such, in fact, is the case, and both the mechanical and electrical engineers, with full appreciation that quality and not quantity gives a society its rank, are most jealous of the privilege of membership. Those unqualified are rigidly disbarred.

There is yet the possibility to be considered that the rank accorded all the societies will be that of the lowest. As to that, it may be asked, which of the three societies on Thirty-ninth Street gives the flavor to the standing of all? Each member of the profession will answer in accordance with his experience, but the Engineering Record feels certain that all but few of the replies will name either the American Society of Mechanical Engineers or the American Institute of Electrical Engineers—not the society with the lowest standards.

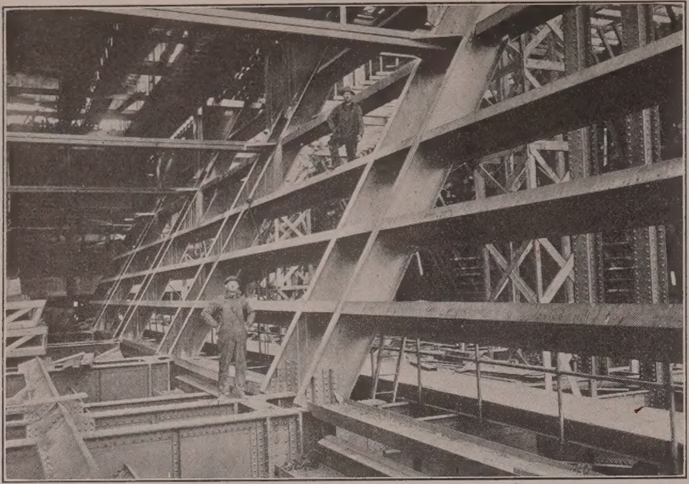
The third and fourth objections can be quickly dismissed. Ten years of co-operation under one roof have not brought the mechanical, electrical and mining engineers a whit nearer "merger" than they were at the start. Each is jealous of its record. Each would oppose most strenuously the loss of its identity.

Contemplation of the fifth objection forces one to exclaim: What a change in the past decade! Then fears were expressed that the "socializing" of the engineer would lower technical standards, that friendship and goodfellowship, while good in their way, must ruthlessly be separated from organizations where intellect must rule. Now, how different the sentiment! Engineering societies are emphasizing the social side of their organizations, appreciating that anything that brings their membership closer together is certain to redound to the advantage of the society, on its technical side, and of the profession as a whole. Far from being a disadvantage, the proximity of the Engineers' Club has been a decided benefit. Committees meeting in the Engineering Societies' Building have been able to adjourn to the club for luncheon or dinner with almost no break in their deliberations, while the good fellowship stimulated by the appointments of the club proves a welcome respite in the stress of a technical convention.

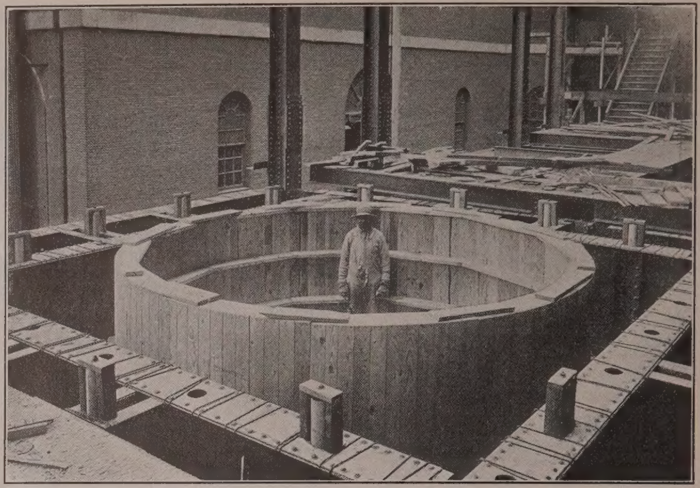
The Engineering Record is not unmindful that other practices of at least one of the societies in the union building have evoked the criticism of civil engineers—practices that did not obtain thirteen years ago, and therefore had no influence on the decision then reached. Objection has been made, for example, to the membership solicitation and the publication of advertisements in its journal by the American Society of Mechanical Engineers. The membership solicitation, however, has been judiciously handled; it has been directed only at well-qualified engineers and has not resulted in the lowering of the standards of the society. Despite its high plane, such solicitation will always earn the disfavor of those who believe that a society should not seek but should be sought. Provided the campaign for new members is properly conducted, the Engineering Record can see no reason for disapproving of it.

On the score of the admission of advertisements to the *Journal* of the American Society of Mechanical Engineers, the Engineering Record is in sympathy with the criticism of this practice. It believes, too, that it is allowing for the prejudice which a publisher would naturally feel toward such a plan. The society has engaged in commercial work—a work grown great through skillful management. The Engineering Record believes that the standing of the society's proceedings has suffered in the estimation of engineers on account of the practice.

On the whole, however, the Engineering Record has believed that the objections raised against the plan thirteen years ago have been removed and that the board of direction of the American Society of Civil Engineers rightly resubmitted the proposal to the society. Those who were against the plan at its first presentation should carefully consider their former objections in the new light.



STEEL FRAMING OF BUNKER WITHOUT BENT CONNECTIONS

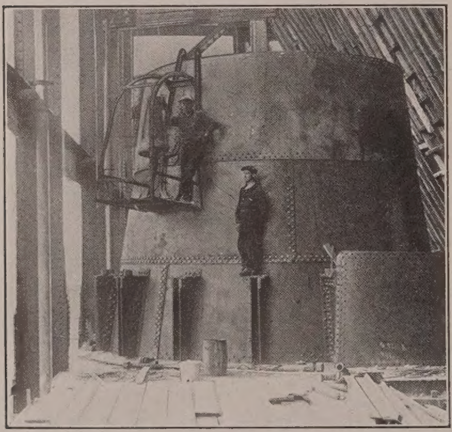


FORMS FOR CONCRETE STACK BASE—HOLES FOR ANCHOR RODS

Philadelphia Electric Company Power Station A-2 Has Four 12-Foot Steel Stacks 165 Feet High

160-Ton Crane Runway and Two 4000-Ton Coal Bunkers Are Other Features of New Steel-Frame Structure, Which Houses World's Largest Steam Turbo-Alternator

THE NEW Power Station A-2 of the Philadelphia Electric Company, located at Twenty-sixth and Christian Streets, Philadelphia, is a steel-frame and concrete structure containing many unusual features. Through the courtesy of Joseph B. McCall, president, and W. C. L. Elgin, second vice-president, of the Philadelphia Electric Company, the following detailed description of the main structural features of this building, on which J. T. Windrim was the architect, can be given.



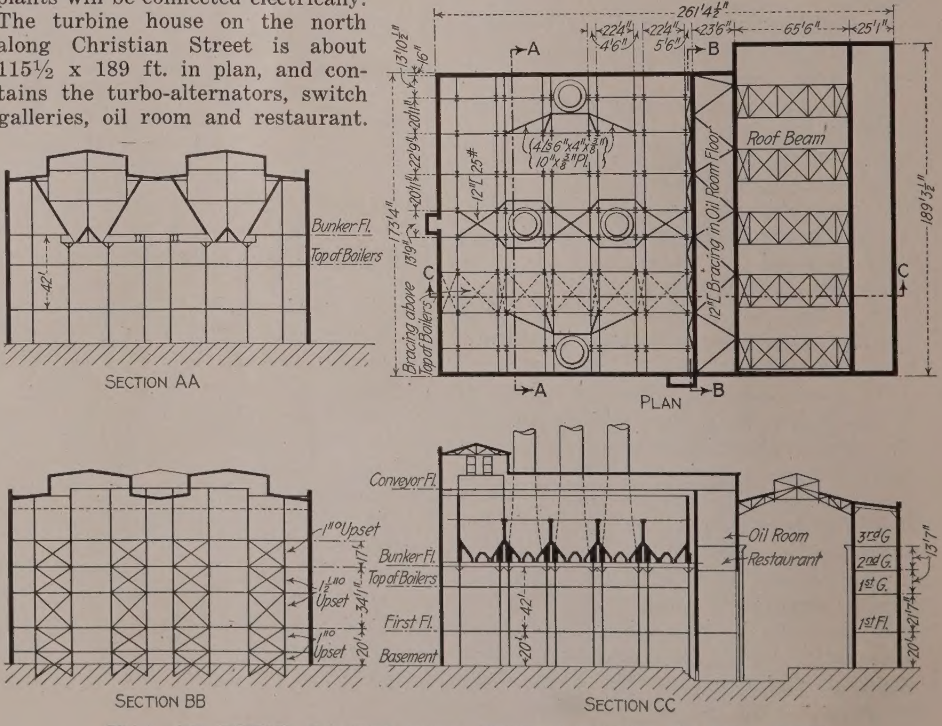
STEEL STACK ANCHORED BY LONG RODS

SPECIAL FEATURES

Four steel stacks, 12 ft. in diameter and 165 ft. high, are supported on the main bunker floor 62 ft. above the basement floor, with provision for resisting uplift and transferring the wind pressure to the foundations. Two 4000-ton coal bunkers have been designed in steel and reinforced concrete in such a way that all bent plate connections were avoided, the sloping bottoms and sides being formed of reinforced concrete. The 160-ton crane in the turbine room required double-beam crane girders braced for lateral forces by diaphragms to adjacent floors. The ceiling of this turbine room is also of special design, using flat tile between steel beams to give an arch effect.

This new power plant will contain the largest steam turbo-alternator in the world, and another almost as large. It will generate 65,000 kw. and control 104,000 kw. of alternating electric current, which would be sufficient to furnish a string of 50-watt lamps 8 ft. apart strung all the way from Philadelphia to the Pacific Coast, assuming a conducting wire without resistance.

The general dimensions of the building are given in the plan and sections in one of the accompanying drawings. The new structure is an extension of the present Station A-1. The east wall of the latter, after the window openings have been bricked up, will separate the two buildings, although the plants will be connected electrically. The turbine house on the north along Christian Street is about 115½ x 189 ft. in plan, and contains the turbo-alternators, switch galleries, oil room and restaurant. A 13-in. curtain wall divides the turbine house from the boiler house in the rear and acts as a fire wall. The building is fire resistant throughout, as brick walls, reinforced-concrete floors and protected steel framing have been used. The main turbine room is seen to be exceptionally spacious, 65 x 188 ft. in plan and about 90 ft. high.



PLAN AND SECTION OF BOILER HOUSE, SHOWING BRACING FOR WIND STRESS

STEEL STACKS AND SUPPORTS

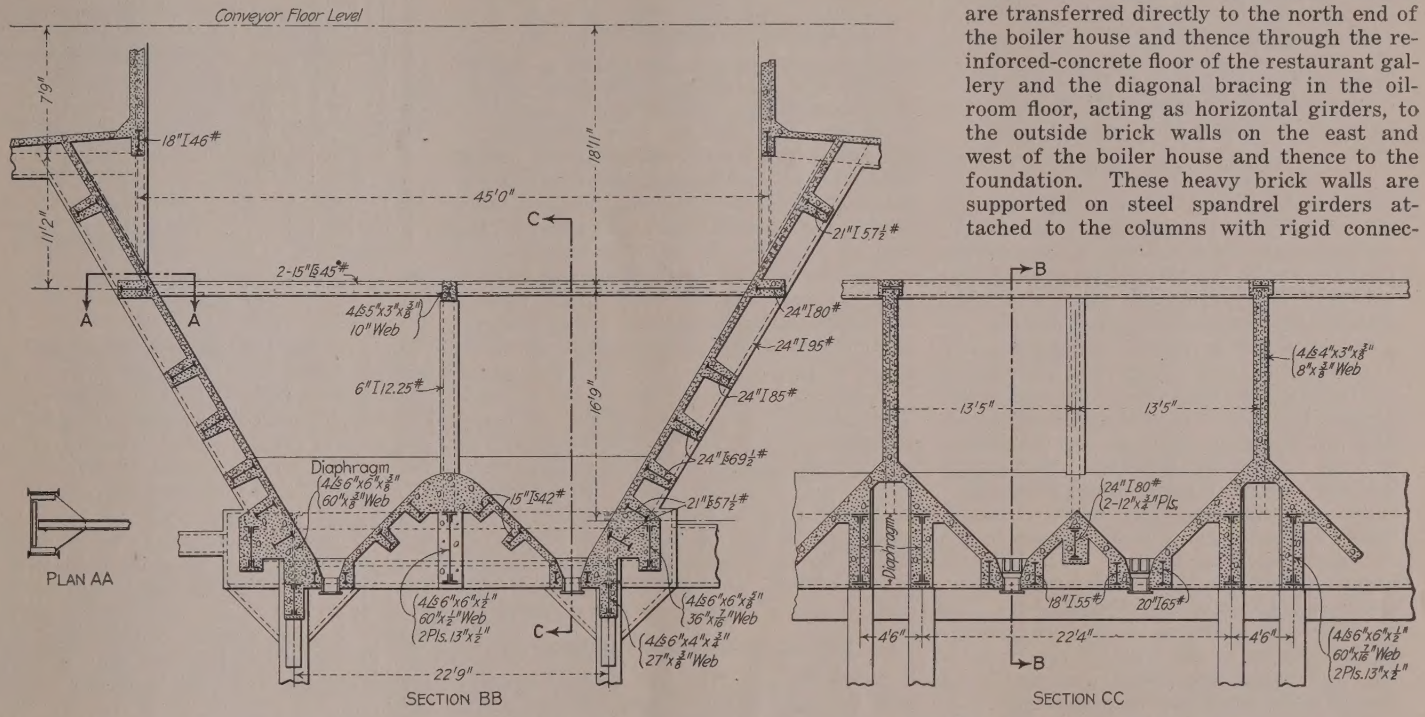
The four steel stacks, with no guys whatever, are each 165 ft. high above the bunker floor, and 12 ft. in diameter, enlarged at the base to 18 ft. Their location is shown in the plan above mentioned and the bracing in the bunker floor indicated by heavy lines. Their total height above the basement floor is 227 ft. Double-web plate girders 4 ft. deep and sixteen 2½-in. anchor bolts, as shown in one of the accompanying photographs, are provided for each stack base. The long bolts between vertical brackets on the lower section of the stack pass through the holes for which the cores are placed, as seen in one of the photographs, the girders being filled with concrete inserted through the open holes shown.

The total wind pressure on the exposed diametral area of one stack is 30,000 lb., and the overturning moment at its base is 3,000,000 ft.-lb. The approximate weight of the stack with its lining is 250,000 lb., and the weight of the concrete base to which the stack is anchored is at least as much again, giving a total of 500,000 lb. Assuming a distance of 10 ft. from this resultant at the center of the stack to a center of pressure at any side of the base, the resisting moment is more than 5,000,000 ft.-lb., without including the effect of dead load of floors and columns below. The overturning effect of the wind on the stack is thus amply resisted. The downward thrusts on the centers of pressure were provided for in the design of the girders and columns and their connections.

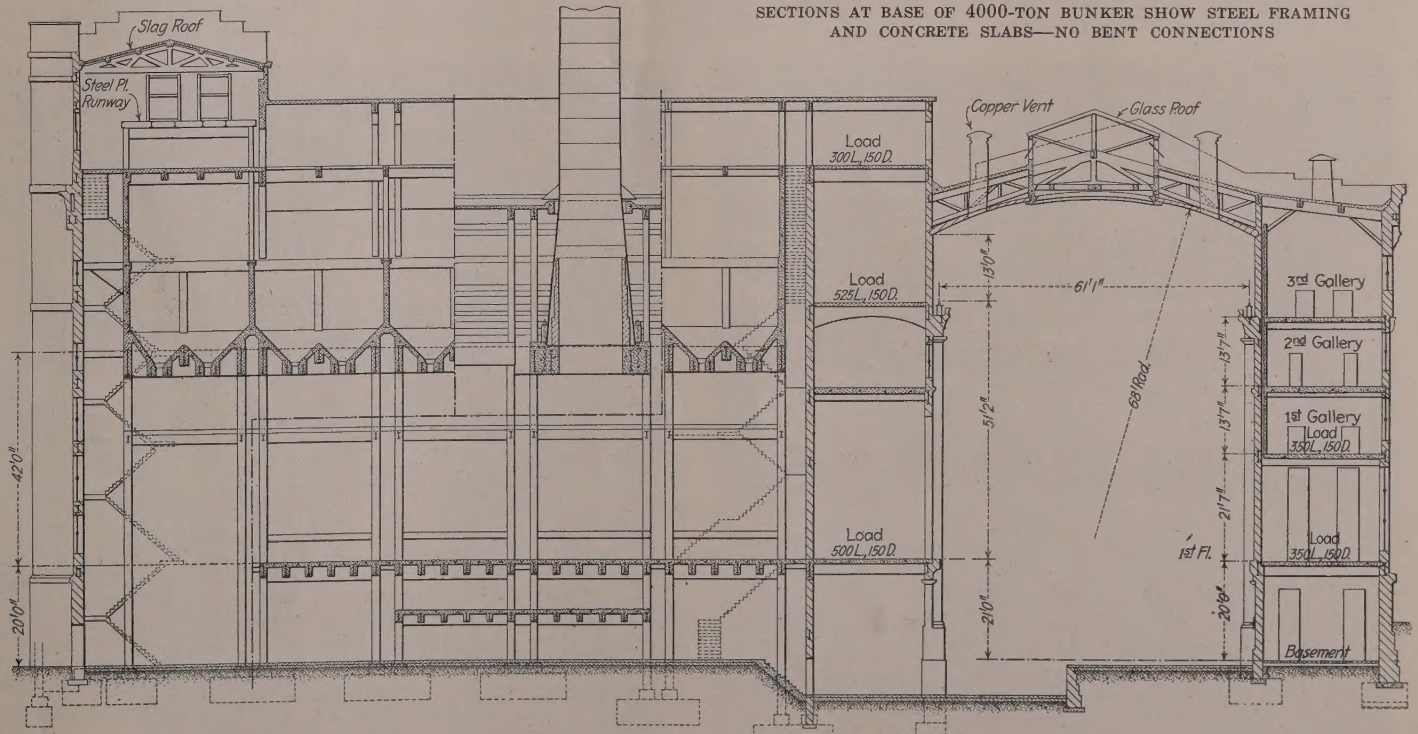
WIND BRACING FOR STACKS

In addition to the overturning effect of the wind, the horizontal pressure at the base of each stack had to be transferred to the foundation about 65 ft. below. As vertical diagonal bracing would interfere with the operation of the boilers, horizontal diagonal braces, as shown in the plan by heavy lines, were used from the corners of the square concrete stack bases. These braces from the two interior stacks distribute the east-and-west horizontal thrusts to the complete bracing system shown in the middle bays, and thence to the ends of this system, up the solid end walls of the bunkers to the horizontal girders at the end, shown by one of the photographs, and into the brick walls on the south end and the rod bracing in the partition wall on the north end of the boiler house. This rod bracing consists of 1¼, 1½ and 1¾-in. upset round diagonal rods, with clevises, in every other bay of the building and connected to brackets riveted to the columns and beams.

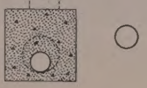
The north-and-south horizontal thrusts are transferred directly to the north end of the boiler house and thence through the reinforced-concrete floor of the restaurant gallery and the diagonal bracing in the oil-room floor, acting as horizontal girders, to the outside brick walls on the east and west of the boiler house and thence to the foundation. These heavy brick walls are supported on steel spandrel girders attached to the columns with rigid connec-

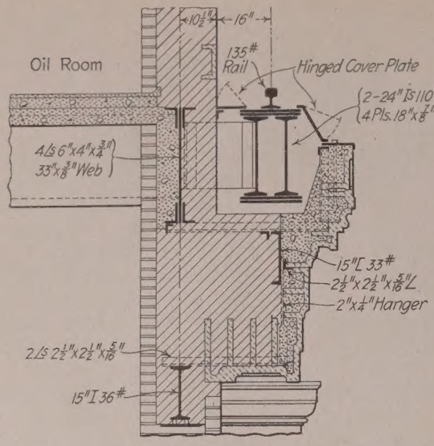


SECTIONS AT BASE OF 4000-TON BUNKER SHOW STEEL FRAMING AND CONCRETE SLABS—NO BENT CONNECTIONS



LONGITUDINAL SECTION LOOKING WEST—BOILER HOUSE ON LEFT AND TURBINE HOUSE ON RIGHT





SECTION THROUGH CRANE GIRDER, SHOWING CORNICE AND CONNECTIONS

tions, so that each side of the boiler house is assumed to be capable of transferring shear to the foundation.

4000-TON COAL BUNKERS

A general view of one partly completed bunker is shown, giving some idea of the size necessary for the 4000-ton required capacity. At the far end are transverse conveyors from which the coal will pass through the hopper-like chutes into the longitudinal conveyors shown on the sides and at the upper part of the picture, from which it drops into the bunkers. The hoppers can be seen below, and in one case the top of a feed pipe leading down to the automatic stokers. The steel framing and concrete walls are shown in detail in the accompanying cross-sections. The 24-in. I-beams frame into a 60-deg. sloping bent consisting of a pair of 24-in. I-beams 4 ft. 6 in. on centers. These bents are tied together at about two-thirds of their height by a pair of 15-in. channels, as seen. The longitudinal beams in the sides of the bunkers at these points are placed horizontally to simplify the details of the connections.

The design of the bunker frame was studied throughout to avoid any hip-and-valley connections, with the result that no bent plates are used. These connections are clearly shown in one of the photographs. The main horizontal girders supported in pairs by columns 4 ft. 6 in. apart are also shown, their sections being indicated on the detail drawing.

DESIGN OF BUNKER FRAMING

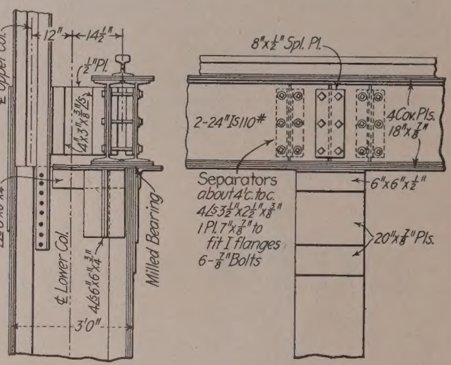
F. N. Kneas, the architect's consulting engineer, who designed the structural work and concrete throughout the buildings, proceeded as follows in designing the bunkers: The crushed coal was assumed to weigh 50 lb. per cubic foot, with an angle of repose of 30 deg. The ratio of horizontal to vertical pressure at any depth would then be 1/3, according to the usual Rankine formula. The resulting horizontal pressure on vertical walls of 16.7 lb. per foot of depth gave a normal pressure on the 60-deg. side walls of 25 lb., as found by the ellipse of stress. On the 45-deg. side of the bunker bottom the pressure was found to be 33 lb. per foot of depth. The bunkers were designed for the resulting normal total pressures, using the unit pressures and the known depths below the top level. Trimmed bunkers were assumed; that is, coal filled to a horizontal level at the underside of the conveyors.

The unit stresses used throughout the design are those allowed for buildings by the Philadelphia building code. The bunkers were designed with intermediate division walls, so that any section could be emptied if fire should start in the masses of coal. The concrete of the bunker slab is made practically watertight by the incorporation of hydrated lime in the mixture to prevent leaks and dripping when the coal is drenched with water. Such concrete was also found to flow more easily, and hence facilitate the pouring of the complicated parts of the bunker. A hard cement finish was applied on the interior bunker surfaces.

SPECIAL CONDITION CONSIDERED

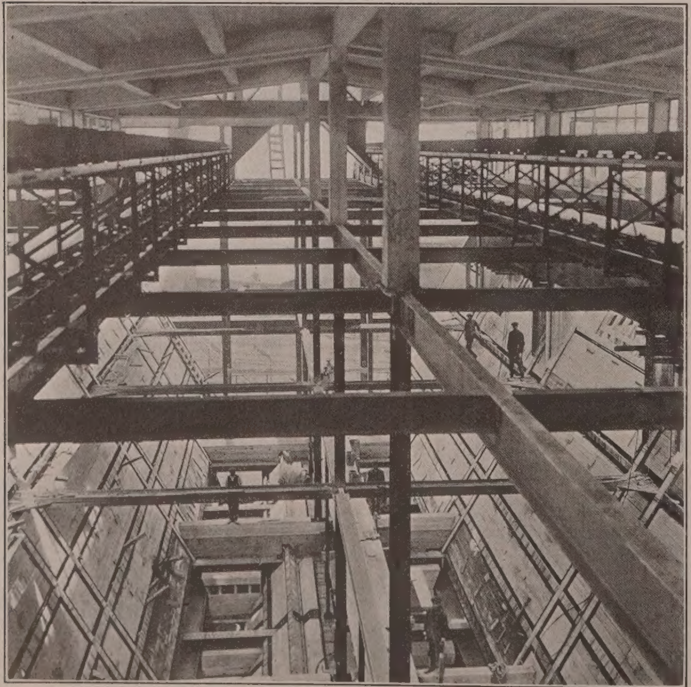
A special condition was further considered by the engineer. Any wetting down of the coal, in case of fire, would decrease the angle of repose and increase the normal pressure. While water would pass through and out the chutes at the bottom, it was assumed that 10 ft. of water above the outlet might be possible. Assuming crushed coal to have 40 per cent voids, 1 cu. ft. of coal weighing 50 lb. would displace 0.6 cu. ft. of water weighing 62.5 lb. or 37.5 lb. The net weight of a cubic foot of crushed coal in 1 ft. of water is therefore 12.5 lb.

By submerging a small test pile of coal under water it was found that the angle of repose was approximately 25 deg. Using the Rankine formula, the net horizontal component for 1-ft. depth of submerged coal is 5 lb., which with the 62.5 lb. water pressure, gives a total of 67.5 lb. fluid pressure on vertical surfaces. On the sloping 60-deg. and 45-deg. sides the total "fluid" pressures were found by the ellipse of stress to be 69.5 and 71.2 lb. respectively. In other words the pressures due to submerged crushed coal were found to be equivalent to those due to fluids weighing from 67.5 lb. per cubic foot when applied to vertical surfaces up to 71.2 lb. per cubic foot on 45-deg. slopes. For this special condition the allowable unit stress in the steel was increased from 16,000 lb. to 20,000 lb. on the extreme fiber.

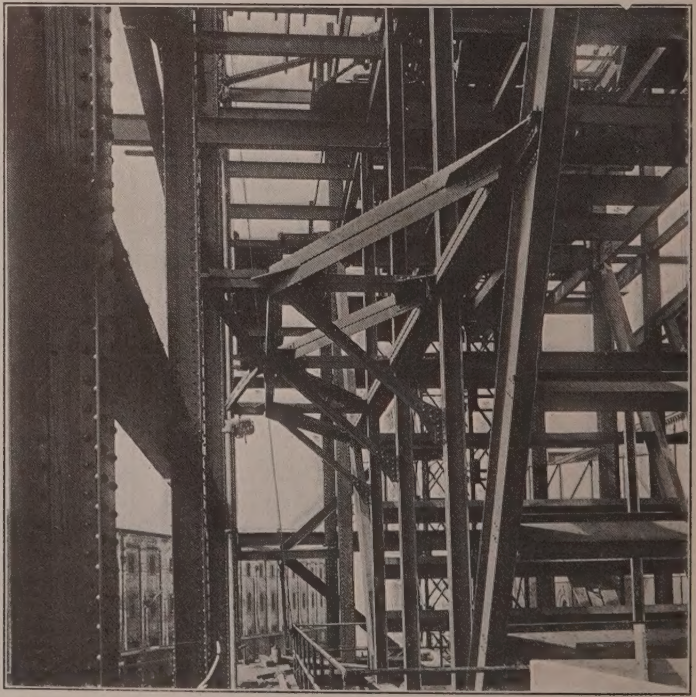


TYPICAL CONNECTION OF HEAVY CRANE GIRDER TO COLUMN

The horizontal girders supporting the end walls of the bunkers are connected by the



VIEW OF LARGE COAL BUNKER WITH FORMS IN PLACE

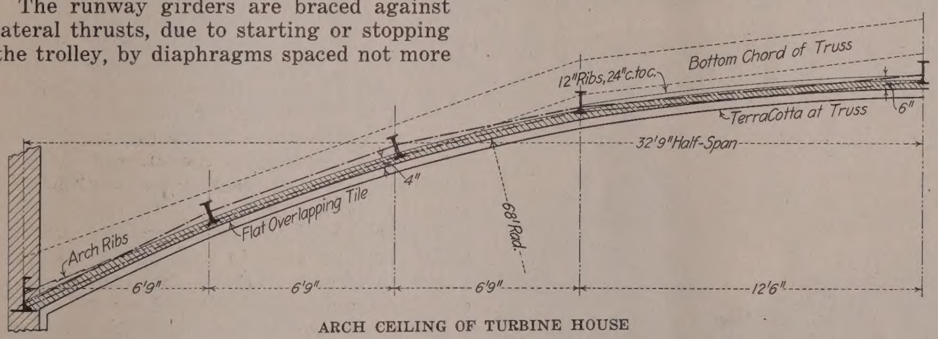


HORIZONTAL TRUSS AT END OF COAL BUNKER FRAMING tie which runs lengthwise with the bunkers, as shown in the detailed drawing, at the top of the division walls. This tie also acts as a strut between the tops of the division walls, and any surcharge on any division wall is carried by this longitudinal tie to the horizontal girders at the end shown in the photograph. The cumulative effect of the simultaneous surcharge on similar sides of the division walls and the end wall has been considered in the design of the girders and the ties.

160-TON CRANE RUNWAY

One of the governing features of the turbine-house design was the 160-ton electric traveling crane spanning 61 ft. between runway girders. The maximum load on each of the four wheels on each runway is 105,000 lb., and the wheel spacing is 6, 10 and 6 ft. The runway girder span is practically 18 ft. between columns. Two 24-in. 110-lb. beams with double top and bottom cover plates were used, the unit fiber stress being assumed at 12,500 lb. to allow for impact. To avoid inward buckling of the top flanges under the concentrated wheel load, steel diaphragms of ⅞-in. web and four angles 3½ x 2½ x ⅜ in., with webs machined to fit the top and bottom flanges, were spaced not more than 4 ft. apart. The details of these diaphragms and the crane girder seat on top of the offset columns are given on the accompanying sketch.

The runway girders are braced against lateral thrusts, due to starting or stopping the trolley, by diaphragms spaced not more than 6 ft. apart and connected to the main columns and to the gallery floor girders. The longitudinal thrusts on the runway due to starting or stopping the travel of the crane itself are carried to the ground by diagonal rod bracing in the vertical walls, three intermediate bays on the north side being braced. The thrust is carried to the division-wall bracing, on the south side by the horizontal diagonals in the oil room. The roof bracing, as shown in the plan, carries the wind pressure to the same vertical plane on the north side, and by diagonals in three vertical bays on the south side down to the oil-room level and thence to the foundations as described above.



ARCH CEILING OF TURBINE HOUSE

ARCHED CEILING AND TESTS

The arched ceiling for the turbine room is built up of overlapping flat tile 1 in. thick, 6 in. wide and 24 in. long to a thickness of from 4 to 6 in. The arch spans about 65 ft. with a radius of 68 ft. and a rise of about 8 ft., but is steadied and partly supported by longitudinal steel channels spaced 6 ft. 9 in. on centers near the springing line and 12 ft. 6 in. on centers at the crown. To take the thrusts ¾-in. tie rods 2 ft. on centers are carried from the approximate centers of pressure at the springing lines though the intermediate steel channels. In addition ¾-in. rods are built into the arch ring itself on alternate 2-ft. centers to supply ties for the reinforced-tile slab action. The latter rods had hooks on the ends and rested upon the bottom flanges of the steel beams. The accompanying detailed sketch shows this construction.

Two tests were made of this tile ceiling and loads approximating 60 lb. per square foot average intensity caused deflections of only 1/50 in. in the short panel near the spring line and 1/30 in. in the long panel near the crown. In one case the load was allowed to remain twenty-four hours and in the other about nine hours without any increase in deflection being observed, and in both cases about 75 per cent of the deflection was recovered upon removal of the load.

Bone Wall Patent Invalid Because Anticipated

Because of Prior Use, Judge Anderson of U. S. District Court in Indiana Sustains Commissioners of Marion County in Suit

BASING his decision mainly on the evidence presented by Prof. W. K. Hatt of Purdue University, showing examples of the previous use of reinforced-concrete cantilever retaining walls, Judge Albert B. Anderson, of the U. S. District Court in Indiana, holds that the Bone patent No. 705,732, issued in 1902, is not infringed by retaining walls of this type as now built, and that the patent was invalid because of the existence of prior art. This decision, handed down Jan. 26 in the case of Frank A. Bone, of Cincinnati, against the Board of Commissioners of Marion County, Indiana, et al., is contrary to that of the district court of Cleveland, which upheld the patent and infringement thereof in the case of Bone against the city of Akron, which decision was affirmed on appeal to the Sixth Circuit Court of Appeals at Cincinnati, and by Judge Trieber in the U. S. District Court at Denver.

The decision of Judge Anderson was the outcome of the presentation by Professor Hatt of the following references showing prior use of the principal idea: (1) Stowell and Cunningham, U. S. Patent; (2) *Deutsche Bauzeitung*, 1894; (3) Rehbein in *Monier und Beton-Bauwerke*, 1894; (4) Nolthenius article in *Tydschrift* vanhet Koninklyk-Instituut, 1896, and (5) Planat's articles on page 610, Vol. 9, 1894, and page 621, Vol. 11, 1895, in *La Construction Moderne*. The principal arguments of this decision which, if upheld, will affect large sections of the country where similar cases are pending, have been abstracted in the following selections from the verbal opinion rendered by Judge Anderson:

FOUNDATION OF PREVIOUS DECISION

It is perfectly evident to my mind that the very foundation of the decision of the Circuit Court of Appeals of the Sixth Circuit, as well as the foundation of the decision of the District Court from which that case was appealed, was wrong; the very foundation of it was wrong. I am firmly convinced either that the matter was not fully presented to the district judge in Cleveland, and that the record was not as fully made up in the Court of Appeals as it is here, or at least that they did not understand it—one or the other.

Judge Day in the previous decision says: "Considering the claims of the patent, and the testimony, I am of the opinion that Bone, the patentee, was the first to reinforce the retaining wall of concrete or masonry in such a manner that the weight of the retained material would be utilized to impart through the reinforcing members tensile resistance to the stem or vertical part of the wall, thereby fortifying this part of the wall against breaking strains."

NEW EVIDENCE PRODUCED

We now know in the light of the evidence in this case, that Bone was not the first to reinforce the retaining wall in such manner. He was not the first person to reinforce a retaining wall; he was not the first to conceive the idea of a reinforced retaining wall which was so shaped and constructed that the weight of the earth on the heel of the wall would withstand the pressure of the dirt or the earth on the wall. It may be that upon the record before Judge Day, Bone was the first person to do this. So far as the record in this case is concerned, the absolute converse of that proposition has been demonstrated.

Further, Judge Day says: "In the present more or less familiar state of the reinforced-concrete art, the impression is natural that there cannot be patentability in the structure of these claims, but the patent was issued upon an application filed in 1899, which was a renewal of an application filed in 1898, and Mr. Bone's idea is shown to have antedated his application. The said invention consists principally of introducing into masonry of concrete, stone or brick a framework of steel or iron in such a way that the whole wall is so much strengthened thereby that the volume of the masonry may be greatly reduced, and yet the height, base and strength against overturning, bulging or settling will still be ample." The record in this case shows a number of things to anticipate that substantial thought.

Judge Day continues: "If the prior art had shown a structure intended for a retaining wall, and having a heel such that the weight of the earth thereon would tend to keep the wall erect, it might be difficult to find invention in merely adding the form of reinforcement most suitable to create the desired tensile strength; but we find no such earlier structures." Now the evidence in this case shows a number of such earlier structures, and so the very foundation of this opinion is taken away by the evidence, assuming that the decision was based upon the record as here given.

REHEARING EVIDENCE ALSO DEFECTIVE

On the application for a rehearing, where the court declined to direct the court below to open the case to permit the defendant to put in a certain German patent after deciding that there was no satisfactory excuse for not producing the proof in due time, the court went on and said: "While the new reference (if it passed the limits of mere suggestion or unsuccessful experiment) would be distinctly pertinent upon the issue of invention, and if properly proved in another case should receive careful consideration, it is not so demonstrative of error in the result already reached as to require its reception."

So the court did not have before it the evidence either on the petition for a rehearing or on the original hearing that this court has on the state of the prior art. There is shown here beyond any question whatever retaining walls, anticipations of retaining walls, publications and descriptions of them which are of the cantilever type.

Now, I think it is going a long way to assert that what the defendants did is an infringement of this patent on either ground; and, inasmuch as I am a mere examining magistrate, and inasmuch as the defeated party usually thinks that the trial court knows nothing about it, and that he will go to a court that does understand it, I will dismiss this bill for want of equity.

A TYPOGRAPHICAL ERROR in the table on page 151 of the issue of Jan. 29, in the article on the relative strength of slag and broken-stone concrete, makes the strength of trap-rock concrete apparently higher at the age of six months than it is at twelve months. The value 4053 given for strength at six months should be 3053.

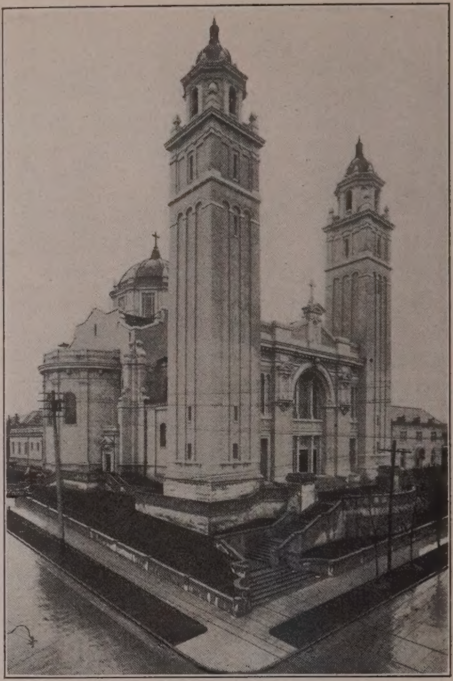
Heavily Loaded with Snow, Cathedral Dome Falls

Unprecedented Snowstorm and Blizzard Piles Snow in Pockets on Roofs and Overloads Supports—Lower Chord of Truss Fractured

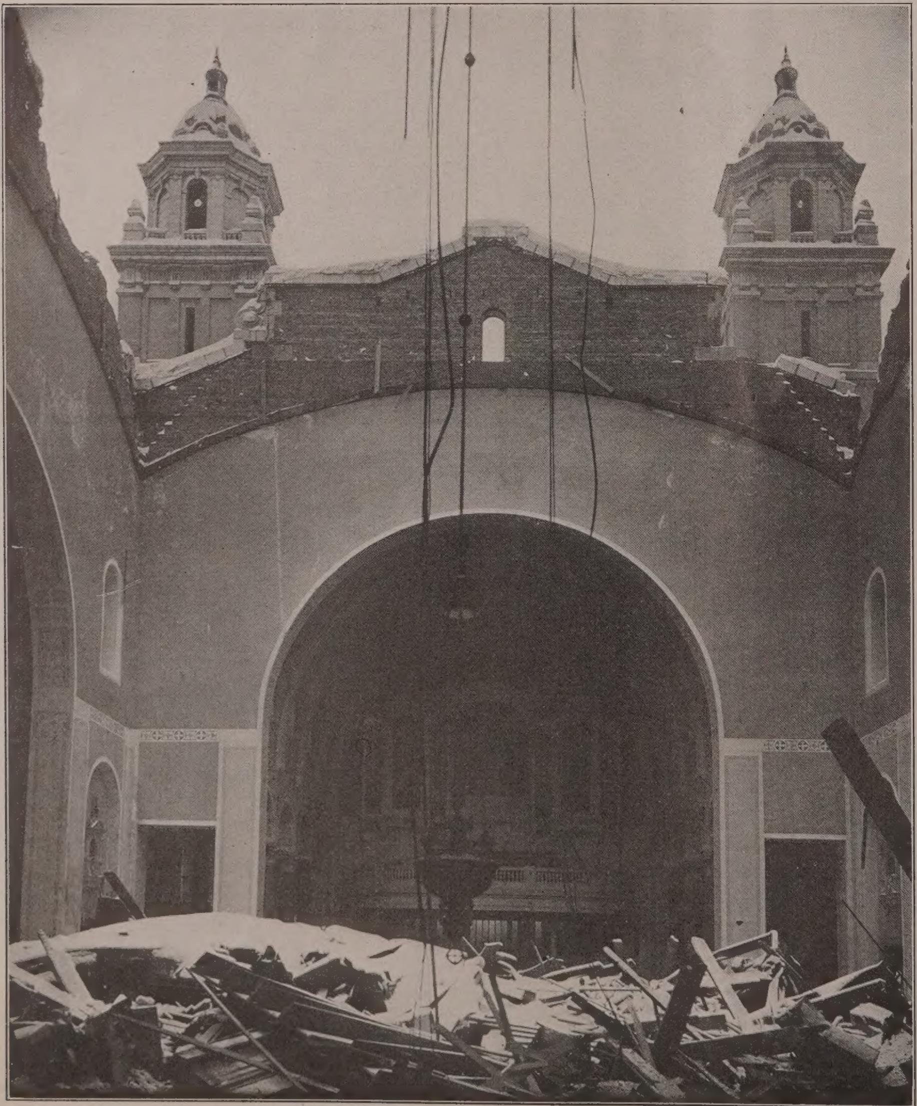
FOLLOWING an unprecedented snow fall for its locality, the supports of the 43-ft. dome of the St. James Cathedral in Seattle, Wash., collapsed on Feb. 2, under the weight of tons of water-soaked snow drifts which had collected in pockets on all sides of the dome, overloading the four steel latticed trusses upon which it rested. Fortunately, the main supporting piers and walls are practically undamaged, as seen in one of the photographs, so that the total loss is estimated as only about $75,000. The city building department is making a thorough investigation of the causes of the failure. The following general facts are based on information from W. M. Somervell, of Somervell & Putman, architects, of Seattle, who was originally in charge of the construction, and from C. G. La Farge, of the firm of Heins & La Farge, architects, New York City, who were the designers of the structure.

GENERAL DIMENSIONS

St. James Cathedral is located at the corner of Ninth Avenue and Marion Street, Seattle, and is shaped like a cross in plan, with a square crossing about 70 ft. clear opening near the center of the building, above which the 43-ft. tower is carried on four intersecting horizontal lattice steel trusses 73 ft. long in two pairs about 44 ft. apart. All of these trusses rested on piers of brick in cement mortar, the piers in one case being buttressed by the curving brick walls of the projecting alcove, and in the other case by steel framing to 12-in. Z-bar columns below.



ST. JAMES CATHEDRAL IN SEATTLE



STEEL TRUSSES FAIL UNDER HEAVY SNOW LOAD AND CATHEDRAL DOME FALLS

The zenith of the copper-covered dome, which can be seen in one of the photographs, was about 115 ft. above the cathedral floor, and about 40 ft. above the supporting trusses, its rise above the springing line being about 21 ft., the dome spring from the top of the octagonal brick wall containing the windows in a drum or tower about 14 ft. high. The dome was steel framed, of eight bent I-beam ribs, with a horizontal I-beam tie at the springing line. The opening of the dome is 70 ft. above the cathedral floor.

SKYLIGHT ADDED AFTER COMPLETION

Owing to difficulty with the acoustics of the cathedral, it was found necessary to seal the dome with a flat glass skylight, some five months after the completion of the building. This was done under the supervision of a local architect, and, of course, added a slight dead load weight to the steel trusses. These four steel trusses were designed to support the whole tower and dome, with wind and only light snow loads, because Seattle seldom experiences heavy snow storms.

One of the photographs shows the pockets outside the octagonal drum in which the snow accumulated. Owing to changes in the direction of the wind during the 36-hr. snowstorm and blizzard preceding the failure, all sides of the roof around the base of the drum was piled about 7 ft. high with drifted snow.

PROBABLE CAUSE OF COLLAPSE

In the opinion of Mr. Somervell, the probable cause of the collapse was defective steel in one of the trusses. The heavy water-soaked snow was found by test to vary from 28 to 35 lb. per cubic foot. This extraordinary load, which one engineer estimated at 30 tons total, seems to have caused the west end of the truss to fail, the lower chord being broken at that end and the diagonal end compression member badly buckled. The fractured steel showed practically no elongation, and the nature of the injury is such that it probably did not result from the fall.

As the four trusses intersected and were spliced at the points of intersection, the failure of one carried down the others, and the whole of the superstructure above collapsed with them. The supporting brick piers and walls are apparently intact. The fact that the side windows blew out under the sudden heavy air pressure caused by the falling dome undoubtedly saved the side walls from failure.

The steel trusses were fabricated by the Des Moines Bridge & Iron Company, of Des Moines, Iowa.

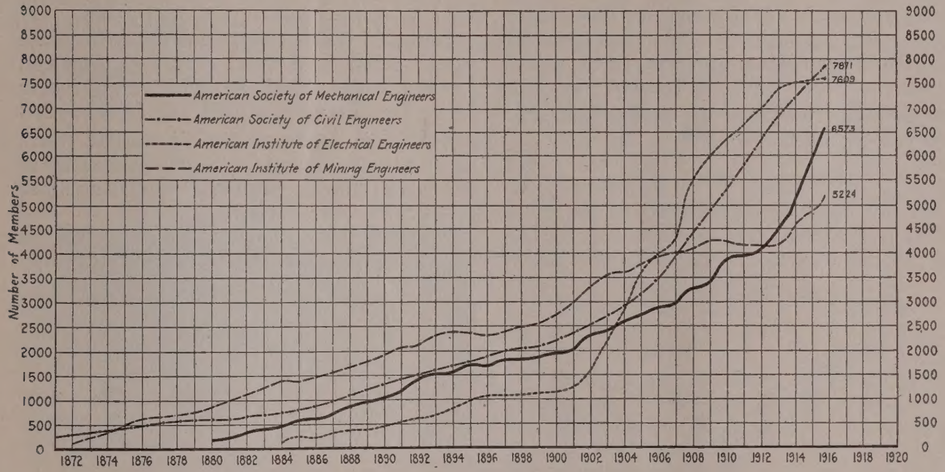
The cathedral was designed in 1905 by Heins & La Farge, of New York City, architects for the Cathedral of St. John the Divine, New York. It was completed in 1906, and dedicated in 1907. The structure cost about $400,000. The present bishop, Right Reverend E. J. O'Dea, has authorized a statement that the work of rebuilding will proceed at once.

TWO WEEKS' VACATION WITH PAY has been voted by the Boston Transit Commission to all its employees on the labor payroll, according to the annual report of the commission.

National Society Membership and Qualifications Compared

IN CONNECTION with the editorial in this week's issue, dealing with the proposal to move the headquarters of the American Society of Civil Engineers to the Engineering Societies Building, the accompanying curves of membership and table of admission qualifications to the various grades are pertinent. In the higher grades of membership it will be noted that the requirements are very similar for the civil, electrical and mechanical organizations. The minimum age for the former is thirty years as against thirty-two years for the others. Both the civil and mechanical bodies specify five years in responsible charge of work as against three years for the electrical society. The mining engineers, it will be noted, are not governed by the detailed admission requirements which obtain in the other organizations.

Other features of the comparison are discussed in detail in the editorial to which reference has been made.



GROWTH OF THE FOUR NATIONAL SOCIETIES FOR FORTY-FIVE YEARS

COMPARISON OF REQUIREMENTS FOR ADMISSION TO AMERICAN SOCIETY OF CIVIL ENGINEERS, AMERICAN SOCIETY OF MECHANICAL ENGINEERS, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS AND AMERICAN INSTITUTE OF MINING ENGINEERS

	A.S.C.E.	A.S.M.E.	A.I.E.E.	A.I.M.E.
	Member	Member	Fellow	Member
Age	30 yr.	32 yr.	32 yr.	All professional mining engineers, geologists, metallurgists or chemists and all persons actively engaged in those branches of engineering.
Design and direction (as principal, important engineering work)	Yes	Yes	Yes	
Practice of profession	10 yr.	10 yr.	10 yr.	
Responsible charge	5 yr.	5 yr.	3 yr.	
Number of references	5	5	5	3
	Assoc. Member	Assoc. Member	Member	Associate
Age	25 yr.	27 yr.	27 yr.	All persons desirous of joining acceptable to the board of directors.
Design (charge of work under direction)	No	No	Yes	
Practice of profession	6 yr.	6 yr.	5 yr.	
In charge of work	1 yr.	1 yr.		
Number of references	5	5	4	3
	Junior	Junior	Associate	
Age	18-31 yr.	21-29 yr.	21 yr.	
Practice	2 yr.	2 yr.		
Graduation from engineering school equivalent to practice	2 yr.	2 yr.	1 yr.	
Number of references	5	3	3	

FIRE LOSSES IN 1915 DECREASED $52,755,000 as compared to the 1914 record for the United States and Canada, according to the records compiled by the *Journal of Commerce*. The total losses by fire last year were only $182,836,000, as compared with $235,591,000 the previous year. This presents the first sign that the educational efforts being put forth to reduce the appalling fire waste are beginning to bear fruit. It is the smallest loss the country has known since 1905.

Newark Commission Urges Importance of City Plan

Comprehensive Report Makes Variety of Recommendations for Both Undeveloped and Built-Up Sections—Studies Embrace Surrounding Towns

NOT ONLY the city of Newark, N. J., itself, but also the surrounding communities which have a collective population almost equal to that of Newark, are embraced in the report of the Newark City Plan Commission, presented recently as the result of three and one-half years of study of the problem. The study is divided into four parts: Streets and transportation of all kinds; recreation and civic beauty; housing and public control of private development; and planning the greater city, and a program for future work. The program assigns work in five-year periods up to 1956. The commission regards the plan presented as tentative; it hopes that criticisms and suggestions will be forthcoming, but that when finally revised the plan will be adopted through a referendum.

STREETS AND TRANSPORTATION

Regarding streets and transportation, the proposed plan includes both new streets for undeveloped sections, and extensive street changes in built-up districts. Five of the latter are proposed, as follows: (1) Extension of Central Avenue from Broad to Market Street—considered the improvement most needed in Newark; (2) straightening of Washington Street at Market Street; (3) extension of Frelinghuysen Avenue to Clinton Avenue; (4) widening of Lafayette Street from Broad to Mulberry Street, and (5) widening of Mulberry Street. Outside of the business district the suggested changes aim at the perfecting of the main rectangular and radial systems and at greater flexibility of the minor system.

In the matter of transportation the commission adheres to the recommendations made in a previous report for the rerouting of street cars. One-way vehicular traffic is recommended for a number of streets, and parking and other traffic regulations are proposed. Provision for adequate and suitable railroad stations, elimination of the remaining grade crossings and the construction of a connecting railroad along the meadow waterfront, with possibly another along Morris Avenue and the Morris Canal, are the steam railroad changes proposed. Expansion of the municipal water terminal now under construction (see the Engineering Record of Aug. 14, 1915, page 201) is suggested as something to be carried out only after years, but to be done according to a definite plan.

PARKS AND BUILDINGS

The second main head includes parks, recreation, public buildings, appearance of city streets, and lot and yard cultivation. The general plan shows numerous new parks, linked up with those in existence by broad parkways. Harmonious location of public buildings, rather than the creation, at considerable expense, of a civic center, is recommended. In the way of artistic public squares, a novel suggestion is the "Ironbound Plaza" proposed at the site of the Market Street Station of the Pennsylvania Railroad, the plan contemplating a large open circle, an octagonal station in the center and the elevated railroad passing diametrically across the circle and through the station. Aside from the recommended expenditures, the commission urges the cleaning up of the city and the substitution by the owner of private property of beauty for ugliness.

With reference to housing, changes are recommended in both the building code and the sanitary code in the light of the most advanced knowledge of the subject, and the need of a permanent housing association is pointed out. Regulation of the heights of buildings, and districting, are also recommended, and the lot-size question discussed.

ADJACENT MUNICIPALITIES

Because Newark itself is now largely restricted as to expansion of area by the numerous separate cities and towns surrounding it, and because these places, though likely to cling to their separate identities, geographically form with Newark one larger city, the Newark City Plan Commission, in co-operation with the Board of Street and Water Commissioners, formed some time ago an organization known as the "Conference on Interurban Improvement of Newark and Adjacent Municipalities" for the purpose of interesting and encouraging neighboring towns in making public improvements with an eye to future development. The Conference found three prime needs: (1) Extension of the major system of rectangular thoroughfares; (2) extension of the system of radial thoroughfares; (3) development of vacant land in conformity with the major and minor street systems. The report points out, however, that the study made by the Conference was brief, and that its conclusions are not final. It is recommended that the laying out of a comprehensive plan for the metropolitan area be undertaken either by the several communities or by a centralized authority.

PROGRAM TO 1956

For the execution of the work in Newark eight five-year construction periods, extending to 1956, are outlined. These, for the first two periods, are in turn divided into non-financial and financial undertakings. During the first period the financial undertakings include the extension of Central Avenue, the straightening of Washington Street, the widening of Lafayette Street, the creation of the Ironbound Plaza, and a number of other improvements. The non-financial undertakings include the revision and adoption of the city plan itself, the revision of various codes, regulations and building lines, the establishment of trolley service on certain additional streets, the making of studies and the dissemination of knowledge on the subject.

The report is signed by Austen H. McGregor, president; Frederick J. Keer, vice-president; Joseph M. Byrne, treasurer, and Christian W. Feigenspan, David Grotta, Augustus V. Hamburg and Gustavus Staehlin, the seven members of the City Plan Commission. George B. Ford and E. P. Goodrich, consulting engineers, of New York City, were retained as expert advisers during part or all of the investigation.

DIAGRAMS SIMILAR TO THE NOMOGRAPHIC CHART described in this journal by G. S. Coleman in a letter to the editor, Oct. 16, 1915, page 489, on the determination of the coefficients in Kutter's formula, have been printed in the pamphlet, "Instructions for Measuring Discharge of Water by Current Meter," issued by the Hydrometric Service of Russia.

Is the Model Weir Unreliable?

Assumption That Flow Over Similar Dams Is Proportional to 5/2 Power of Linear Dimensions Seems to Be Sound

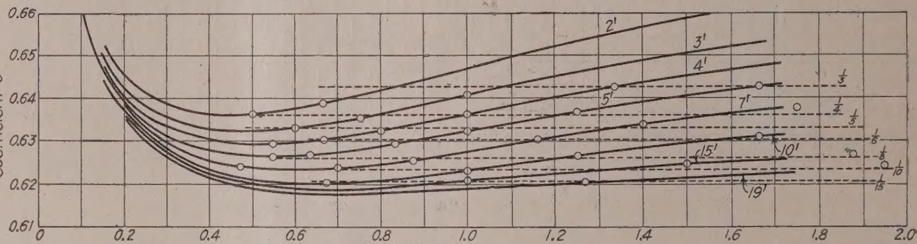
By BEN D. MOSES
El Paso, Tex.

THE ENGINEERING profession is today confronted most seriously by the problem of water measurement. Small quantities in closed conduits are handled to more or less satisfaction by different types of meters, but for streams and open channels rough approximations by the use of empirical formulas are the best that can be done. Frequently some one steps to the front with some plan, possibly of chemical measurement or velocity meters, all of which fall short of the mark for one reason or another. But there is one that presents us with a means that, if founded on sound principles, will enable us to cope satisfactorily with many hitherto impossible problems. It is the model weir.

ERRORS OF MODEL DAM

In the Engineering Record of Aug. 16, 1913, page 193, there appeared an article on the use of a model dam for the determination of the flow on a rather large structure, and the article, aside from describing a unique device, presents us with the suggestion of using models for the obtaining of rating curves for streams too large for weirs or meters. The article closes with a summation of possible errors, as follows:

"In summing up the probable sources of error in the above method we may consider them under the following heads: (1) Errors in hydraulic measurements of the flow over the model; (2) errors in drawing the rating curves; (3) errors in assuming the flow over similar dams to be proportional to the 5/2 power of their linear dimensions; (4) errors in the construction of the model."



RATIOS OF LENGTH OF CREST TO HEAD ON IT POINT TO CONSTANCY OF COEFFICIENT *c*

QUESTION OF PROPORTIONAL FLOW

Errors 1, 2 and 4 have to do only with the personal side of the question and may be entirely waived in a consideration of the soundness of the principles underlying such a method. No. 3, then, may be considered the pillar supporting the entire structure.

This article is not intended as a conclusive proof of the accuracy of the assumption of No. 3, but as an investigation only. There are several methods of attack. One will be taken up at present, and is simply an application of a statement in the article mentioned above, to wit:

"If the curves of the coefficient, *G*, in terms of head, *h*, and for different breadths of notch up to 19 be examined in Hamilton Smith's 'Hydraulics,' it will be noted that the constancy of this coefficient holds within 2 per cent throughout the entire range of contracted and suppressed weirs, down to a breadth of 7 ft. and head of 3/10 ft."

Plate VII in "Hydraulics," by Hamilton Smith, Jr., is a plat of the coefficient *C*. These curves have been traced in the illustration herewith, and the points on the several curves, representing the same ratio h/l (l being the length of the crest and h the head over the crest) picked off. It is interesting to note that these points fall very closely on a straight horizontal line, pointing toward the constancy of the coefficient *C*. To be a little more clear, take the proportion $h/l = \frac{1}{8}$. The points will be obtained for each case by simply dividing the length by 8. For $l = 15$ ft., the head must be $15/8 = 1.875$. Similarly on $l = 10$ ft., $h = 10/8 = 1.25$; on $l = 7$ ft., $h = 7/8 = 0.875$; on $l = 5$ ft., $h = 5/8 = 0.625$; on $l = 4$, $h = 4/8 = 0.5$, and so on.

It would seem, then, that *C* is the same for all suppressed weirs over 7 ft. long and for the special head, ml, where $m =$ factor h/l. Or, broadly stated, *C* in $Q = 2/3\, cbh\sqrt{2gh}$ is constant for all similar weirs having the same ratio h/b. One value for m has been followed through, but other values produce the same result.

The curves for the suppressed weir have been used in preference to those of the fully contracted in the face of the fact that because the contractions are independent of the head, discordant effects of the factor h/l would enter into the relation to an exaggerated degree for small weirs. The straight-line tendency is, however, noticeable for the longer crests.

APPLICATION

A simple case will demonstrate the applicability of the above method. Assume that the weir in hand, with the approach-downstream channel and bottom, has been carefully reproduced in model, all linear dimensions of which are 1/20 of those corresponding on the actual. The model, too, is small enough to be calibrated correctly by the use of a standard weir.

Now the rating curve obtained by careful calibration can be converted into one for the actual by simply multiplying all "quantities" by $(20)^{5/2} = 1789$, and all "heads" by 20. Suppose, for instance, it is required to find the discharge over the weir when the water rises to a height of 10 ft. over the crest, and that the quantity over the model for 6 in. (10 ft. ÷ 20) is 15 sec.-ft. Then the quantity sought is $15 \times 1789 = 26{,}835$ sec.-ft.

GOVERNMENT TIMBER PURCHASES IN CALIFORNIA during the last fiscal year totaled 43,893,000 ft. b.m., of which 35,841,000 ft. b.m. was cut for commercial purposes, and the remainder was supplied to homesteaders or was removed from the forests by permission and without charge. When sold to homesteaders the price is 50 cents per thousand feet.

Analysis and Tests Held to Show Advantages of New Flat-Slab Reinforcement

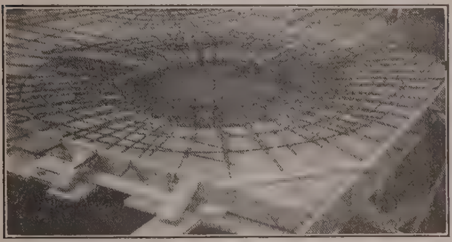
Part 2—Tests of Full-Size Flat Slab and of Circumferential Cantilevers Reported and Discussed—Steel Stresses Measured

By EDWARD SMULSKI
Chief Engineer, S-M-I Flat Slab System Company, Boston

FOLLOWING the theoretical discussion of the new system of combined radial and circumferential reinforcement for flat slabs presented in Part 1, in last week's issue, page 217, there will here be detailed the results of a series of practical field tests. These tests were made for the purpose of determining the carrying capacity of slabs built with the new type of reinforcement, and to find the relative effectiveness of steel placed in rings, as radials and in bands as in the older two-way and four-way systems.

TEST OF 20-FOOT FLAT SLAB

To determine the carrying capacity of a slab designed by the Smulski flat-slab system, two slabs were tested, one of which will be described. Deflection and extensometer readings were taken, but are not given, because the stresses in the steel at the maximum applied load were comparatively small, due to the fact that the test was in the stage where the tensile value of concrete was not yet destroyed. The test will serve, however, as a good comparison with a similar test in which the steel was arranged according to another system.



REINFORCEMENT OF 20-FOOT TEST SLAB

The test slab was 20 ft. square, and was supported by four columns spaced 12 ft. on centers in such a way that the slab projected on all sides 4 ft. beyond the centers of the columns. The purpose of the projections was to create a condition of continuity by causing negative bending moment at the supports. The thickness of slab was 4½ in. and the mild steel reinforcement is shown in one of the photographs. Unit *C* at the column head consisted of twenty ½-in. round radials, five ⅜-in. round outside rings and one 1-in. round center ring.

The positive bending moment reinforcement of the 12-ft. panel in each quarter consisted of four half-units *A* composed of three and a half ⅜-in. round straight bars, and one Unit *B* composed of five ⅜-in. round rings and five 5/16-in. round effective diagonal bars. The slab outside of the 12-ft. panel was reinforced at each side with six ⅜-in. round straight bars parallel to Unit *A*. The weight of steel within the 12-ft. panel was 2.1 lb. per square foot. The slab was poured Dec. 8 and 9, 1913, and the test was started the latter part of March, 1914. To prevent arching of the material, the broken stone loading was applied in boxes 6 ft. 4 in. square, leaving approximately 6 in. between the boxes.

The photograph herewith shows the total maximum applied loading of the slab, which consists of 6 ft. of loading material placed uniformly over the whole slab, equivalent to 600 lb. per square foot, and up to about 10 ft. 6 in. in the central part of the slab. The total test load was about 130 tons. The load, however, was left on the slab five months in order to determine the long-time effect. The stresses at the column head were very low, and only two faint hair cracks developed. The cracks at the bottom of the slab were more definitely developed, but the stresses did not reach the elastic limit.

Based on bending moments specified for flat slabs by the Chicago Building Department, the computed stresses in the steel for the test load within the 12-ft. panel would be, at the column head, about 60,000 lb. per square inch, and in the center of span, 50,000 lb. per square inch, or far above the elastic limit of mild steel.

It is of interest to compare the results of the above test with the results of the tests published by H. T. Eddy in his book on the "Theory of the Flexure and Strength of Rectangular Flat Plates," where a similar slab test is cited on page 92, in which bands of rods were used. The span of the slabs in both cases was the same, but the slab described by Professor Eddy was 6 in. thick instead of 4½ in. and the weight of steel within the area of the 12-ft. panel was 2.42 lb. per square foot instead of 2.1 lb. per square foot. It completely failed under a load of 120 tons, while the above test slab carried about 130 tons without sign of weakness.

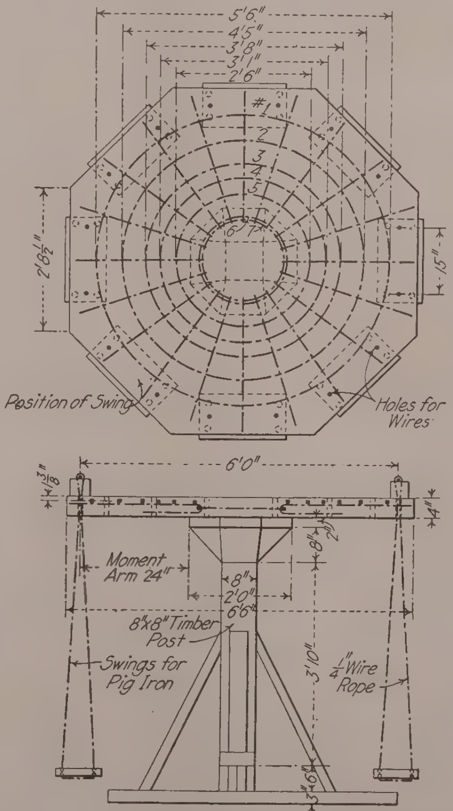


FIG. 5—OCTAGONAL TEST SPECIMENS AND TIMBER-TESTING PLATFORM

TESTS OF CIRCUMFERENTIAL CANTILEVERS

The general discussion of flat slabs given in Part 1 pointed out that the most important part of a flat slab is the circumferential cantilever at the column. The tests here described were designed to study the action of circumferential cantilevers with various arrangements of reinforcement. The results are applicable to flat slabs.

The purpose of these tests was (1) to determine the effectiveness of the rings, (2) to determine the most efficient combination of rings and radials, (3) to compare the effectiveness of the reinforcement placed in bands, as in the two-way and four-way systems, with the reinforcement placed in the direction of the stress.

MAXIMUM LOAD APPLIED TO SLAB

Concrete in the proportion 1:2:4 was used. The compressive strength of blocks, 6 x 6 in., made at the time of pouring the specimens, cured under the same conditions as the test specimens and tested at an age of 52 days, was 2100 lb. per square inch. The estimated strength of 8 x 16-in. cylinders at 28 days on the basis of the above test was 1385 lb. per square inch, or lower than first-class 1:2:4 concrete. Round bars of plain mild steel, with an average elastic limit of 35,000 lb. per square inch, were used. The age of specimens 1 to 6 ranged from 35 to 47 days. Specimens 7 and 8 were 51 and 50 days old respectively.

DIMENSIONS AND REINFORCEMENT OF SPECIMENS

Fig. 5 shows the dimensions of the specimens, which were octagonal in shape, 6 ft. 6 in. inside diameter. The column head, also octagonal and built monolithic with the slab, was 2 ft. in diameter. The reinforcement of specimens 1 to 4 is shown in the table and in Fig. 5. Specimens 5 and 6 were similar except that the number of radials was reduced from 20 to 10 and 5 respectively, combined with five ½-in. rings. The reinforcement of specimen 7 consisted of four layers of rods in each of the four directions, with nine 5/16-in. round rods per layer. Specimen 8 was reinforced with steel in top and bottom; the tensile reinforcement consisted of two layers placed at right angles, with twelve ⅜-in. round rods per layer, and the compressive reinforcement consisted of two layers with eight ⅜-in. round rods per layer.

The concrete was mixed by hand on the cement floor of the shed. Four laborers were used who had had experience on actual construction, and four specimens a day were poured. The specimens were stored in a shed at a temperature of between 50 and 60 deg., maintained by means of a salamander. The steel was wired by common laborers and the rings were less regular in shape and spacing than obtained in actual construction, where they are assembled to a template. Especially marked is the irregularity in specimen 3, in which the space between ring 1 and ring 2 was much larger than intended, which contributed in part to the failure of the specimen.

Preparatory to the test gage holes about 1/32 in. in diameter were drilled in the exposed steel. Particular care was required to space the holes in the steel rods as near 8 in. apart as possible, and to make them round and perpendicular to the body of the bar.

METHOD OF TESTING

The specimens weighed approximately 1 ton each. The testing platform was constructed in such a way as to prevent overturning, as shown in Fig. 5. The load was applied at sixteen points along the circumference, 2 ft. from the column head, each specimen being provided with sixteen holes spaced uniformly around its circumference. During testing, eight swings were suspended from the specimens by means of wire rope passing through the holes, and the swings were loaded with pig iron. It took from two to three days to test one specimen.

In specimen 4, which contained the strongest reinforcement, readings were taken after the application of sixteen pigs per swing, while in specimen 1, with the weakest reinforcement, only six pigs per swing constituted a load. In specimens 3 and 4 the capacities of the specimens were larger than the weight of pigs which could be placed in the swings, therefore it was necessary to place additional load on the top of these specimens. This was placed on two supports so that the resultant nearly coincided with the points of application of the swings.

The pigs were uniform in size, so that a pig could be accepted as a basis of figuring the load, the average weight per pig being 56 lb. In loading the pigs were applied indiscriminately, so that it is a fair assumption that the number of pigs multiplied by 56 lb. represented the actual loading on the swings. One of the photographs shows the maximum applied load on specimen 1.

DEFORMATION READINGS TAKEN

Deformation readings after each load were taken on 8-in. gage lines by means of a Berry extensometer loaned by the Massachusetts Institute of Technology. The position and number of gage lines are shown in Fig. 6. Fig. 7 shows the stress diagrams. In plotting the diagrams, all the individual readings for the same rings were averaged, as the difference between deformation readings on different gage lines on the same ring were, as a rule, small.

For the radials the averages plotted first are for the group of inside gage lines A_1 B_1 C_1 D_1, then for group A_2 B_2 C_2 D_2, etc. For specimens 7 and 8 curves for each of the bars were drawn separately, because their position in the specimen was different and the assumption of equal stresses not justified.

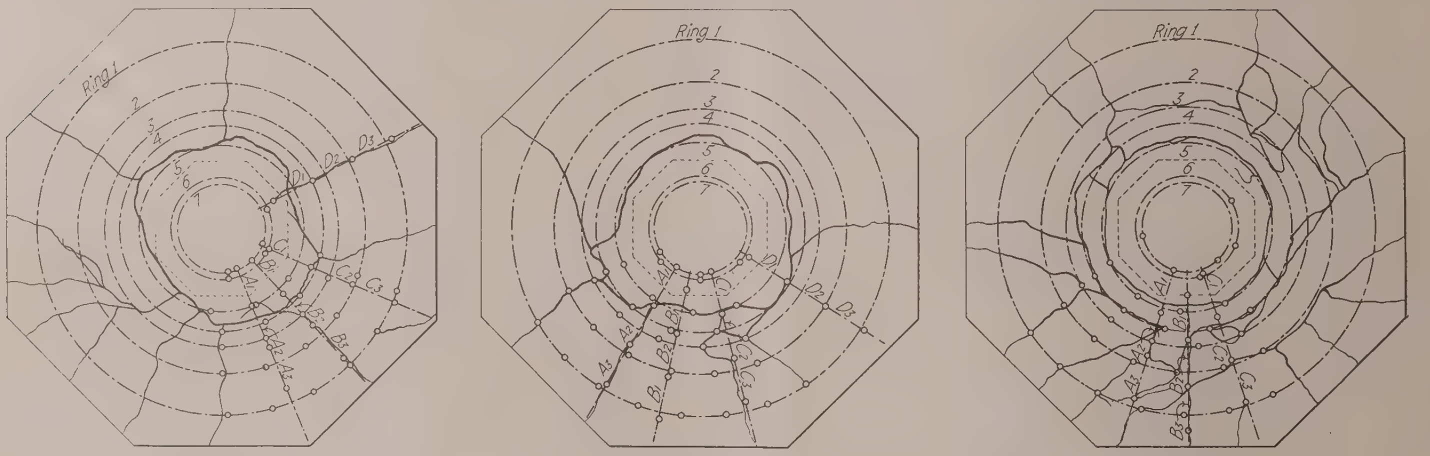
RESULTS OF TESTS

The accompanying table gives the results of the tests. Specimens 1, 2, 7 and 8 were loaded to the elastic limit of the steel. In specimen 3 at the load of 28,000 lb. the wires supporting two of the swings broke and the impact of the fallen pigs weakened the specimen so that after the load was replaced and reached 29,500 lb., one corner was broken off before the elastic limit of the specimen was reached. At the place of failure the rings were misplaced, so that the actual distance between rings 1 and 2 was 8 in. instead of 6 in. as contemplated, thereby putting more than its share of stress in ring 1 and thus contributing to the failure. The rest of the circumference of specimen 3 did not show any weakness at the time the corner broke off, and the stress diagrams show that the measured stresses at the time of failure were below the elastic limit.

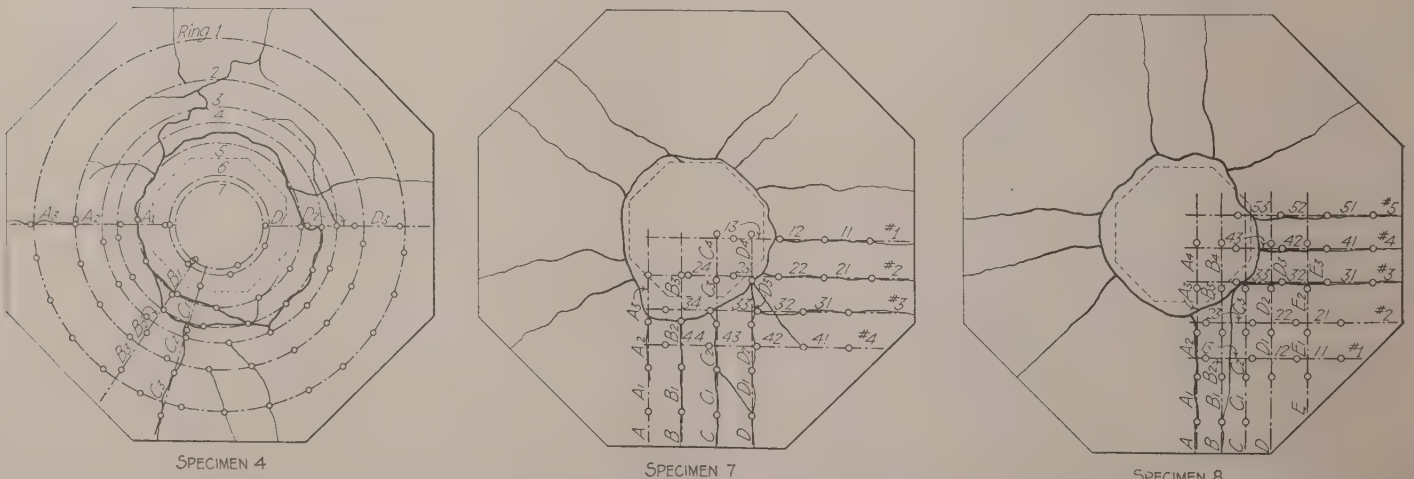
In specimen 4 the maximum applied load consisted of 640 pigs (35,800 lb.), after which further loading was abandoned before the elastic limit was reached, on account of the difficulty of placing more material and the danger to the workmen. The loading of specimens 5 and 6 was abandoned before the elastic limit was reached.

FIRST VISIBLE CRACKS

The first visible cracks appeared at loads and stresses in steel given in the table, columns 19 and 20. Judging from the stress



SPECIMEN 1 SPECIMEN 2 SPECIMEN 3



SPECIMEN 4 SPECIMEN 7 SPECIMEN 8

FIG. 6—POSITION OF GAGE LINES ON STEEL REINFORCEMENT AND CRACKS ON UPPER SURFACE AFTER TESTING

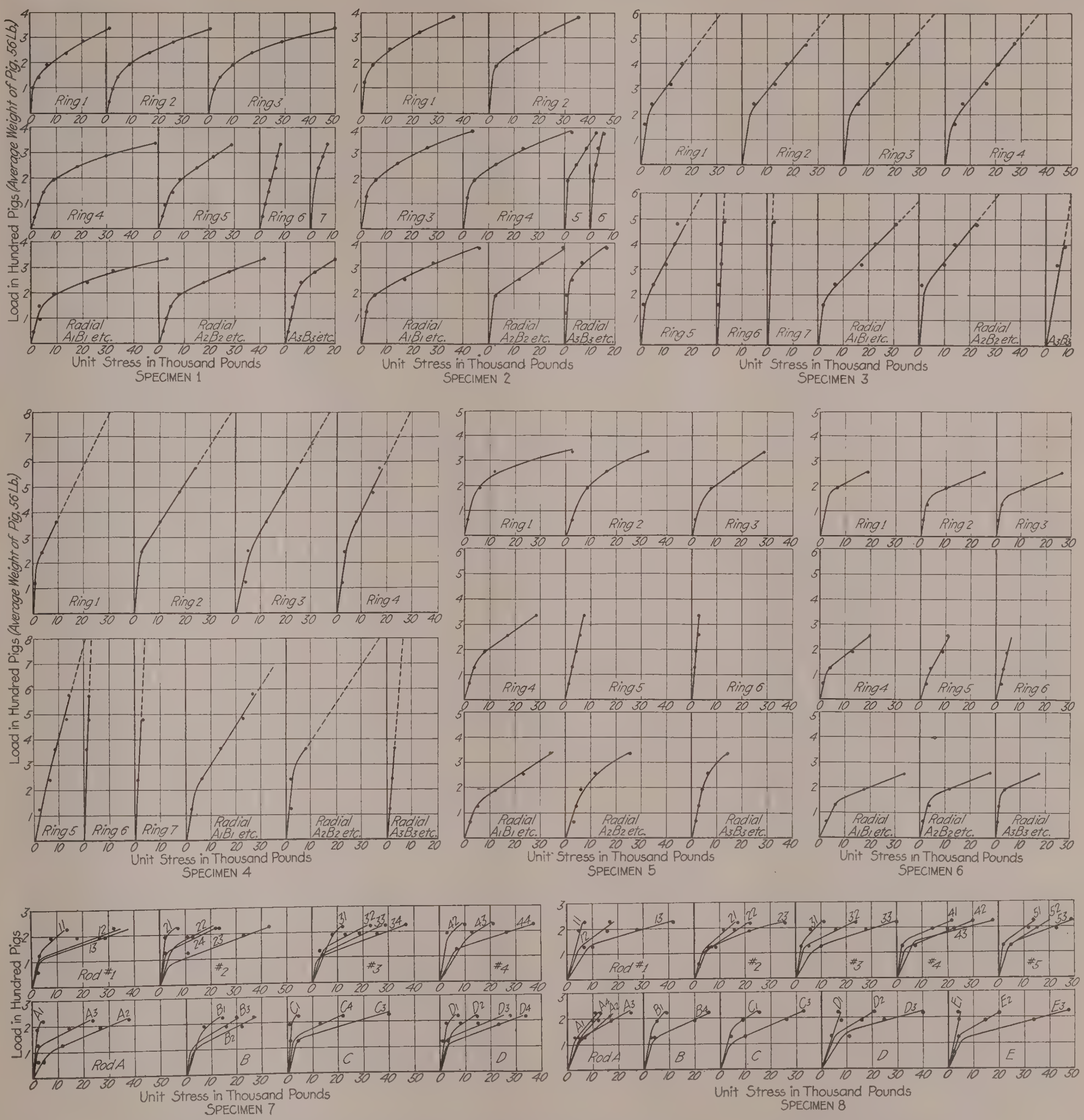


FIG. 7—STRESS DIAGRAMS SHOW RELATION BETWEEN TOTAL APPLIED LOAD AND UNIT STRESSES IN REINFORCEMENT

SUMMARY OF RESULTS OF TESTS OF CIRCUMFERENTIAL CANTILEVERS

Octagonal slab 6 ft. 6 in. inside diameter; column head 2 ft. diameter; 1:2:4 concrete; mild steel.

					NUMBER AND DIAMETER OF ROUND BARS IN INCHES						AT ELASTIC LIMIT f_s=35,000 LB. PER SQUARE INCH								
Specimen No.	System	Age, days	Total thickness of slab in.	Weight of tensile steel, lb.	Radial bars	Outside rings	Straight bars	Area of radial or straight bars around circumference sq. in.	Area of effective rings, sq. in.	Average effective depth, in.	Tota load at elastic limit, lb.	Static bending moment, in.-lb.	Moment of resistance, in.-lb.	Difference between moments Col. 13—Col. 14, in.-lb.	Moment of resistance of single cross-section of effective rings, in.-lb.	Effectiveness of rings Col. 15÷Col. 16, ratio	Load per pound of tensile steel Col. 12÷Col. 5 lb.	Load at first visible crack, lb.	Measured stress in steel at first visible crack, lb. per sq. in
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
1	S-M-I	47	4	42.6	20—$\frac{3}{8}$	5—$\frac{5}{16}$	......	2.2	0.368	2.56	18,800	450,000	172,000	278,000	28,800	9.65	442	12,400	14,000
2	S-M-I	44	4	50.2	20—$\frac{3}{8}$	5—$\frac{3}{8}$	......	2.2	0.484	2.62	22,500	540,000	177,000	363,000	39,000	9.30	448	15,000	15,000
3	S-M-I	42	4	71.7	20—$\frac{3}{8}$	5—$\frac{1}{2}$	......	2.2	0.901	2.60	32,000	*768,000	175,000	593,000	71,800	8.27	447	21,200	16,000
4	S-M-I	35	4	101.2	20—$\frac{3}{8}$	5—$\frac{5}{8}$	......	2.2	1.38	2.50	42,500	†1,020,000	169,000	851,000	105,900	8.10	421	26,600	15,000
7	4-Way	51	4	62.0	......	......	36—$\frac{5}{16}$	5.5	......	2.25	12,600	302,000	376,000	—74,000	......	......	203	8,950	15,000
8	2-Way	50	4	58.0	....	Tension Compression	24—$\frac{3}{8}$ 16—$\frac{3}{8}$	5.3	......	2.25	12,600	302,000	364,000	—62,000	......	......	217	8,900	15,000

Moment of resistance equals area of radials or straight bars multiplied by $\frac{7}{8}$ effective depth times 35,000 lb.
Load times moment arm of 24 in. gives Col. 13.
*Estimated from stress diagram. Broken by accident at 29,500 lb., before elastic limit was reached.
†Estimated from stress diagram. Elastic limit not reached at maximum applied load.

diagrams, cracks invisible to the eye must have appeared at a smaller load corresponding to the break in the deformation curve. The first crack, at first hardly noticeable, extended all the way around the circumference of the column head about 2 in. from its edge. With additional loading this crack opened slowly and additional circumferential and radial cracks appeared. The extent of the cracking at final load is seen from Fig. 6. In all specimens the cracks were larger in number and size in the part where the tensile value of the concrete was destroyed by the gage holes, and where initial cracking was caused by the drilling of the holes in the concrete. It is especially noticeable above the radials and straight bars with gage lines. After the load was removed the cracks closed.

No cracks developed within the column head although the radials were stressed to the elastic limit and did not bear against the center ring.

EFFECTIVENESS OF REINFORCEMENT

The effectiveness of the rings was determined by computing the area of radials required to produce a moment of resistance equal to the difference between the bending moment and the moment of resistance of the radials. The ratio of the resulting area to the cross-section of the outside rings gives the effectiveness of the rings. In determining the cross-section of the rings, the outside rings 1 to 4 were considered as fully effective, because, as is evident from the stress diagrams, the stresses in the rings were equal. The stresses in ring 5 were much smaller than those in the remaining outside rings, which can be explained by the fact that it was placed too near the column head and was therefore only partly effective. The effectiveness of this ring was reduced in the ratio of the stresses resisted by it to the stresses in rings 1 to 4 at the same load, because if properly placed ring 5 would resist the same stresses as the other rings

MAXIMUM LOAD APPLIED TO SPECIMEN 1

In the table, column 17, is given the effectiveness of rings for specimens 1 to 4, which ranges from 8.1 for specimen 4 to 9.65 for specimen 1. The effectiveness of the rings in specimens 3 and 4 is much smaller than in specimens 1 and 2, which points to the fact that probably the estimated ultimate loads are smaller than the actual capacity of the specimens.

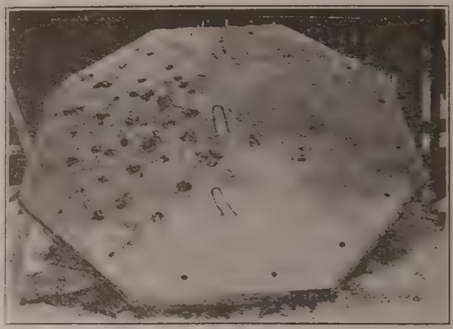
Comparison of specimen 3 with specimens 5 and 6, which differed only in the number of radial bars, shows that although the reduction in weight of steel by the omission of radial bars in the latter was small, specimen 3 showed much greater stiffness and larger ultimate load.

Comparison of the efficiency of the steel in specimens with radial bars and rings and specimens with bands is obtained by inspection of the table, column 18, giving the load per pound of tensile steel obtained by dividing the total ultimate load by the weight of tensile steel in the specimen. From comparison of specimens 7 and 8 with specimens 1 to 4, we find that specimens 1 to 4 carry more than double the load per pound of steel carried by the specimens with band reinforcement.

CONCLUSIONS

The following conclusions can be given:

1. Rings form a very effective reinforcement where stresses in two directions are to be resisted.
2. The effectiveness of a ring as circular cantilever reinforcement, the tests show, is equivalent to 9.65 times the area of a radial bar of equal cross-section where the rings resist 60 per cent of the total bending moment and 8.1 times the area of a radial bar of equal cross-section where the rings resist 82 per cent of the total bending moment.
3. The minimum distance of the first outside ring from the edge of the column head should be at least equal to the depth of the slab to develop the full tensile value.
4. The center ring takes very little stress. It is, however, necessary to keep the radial bars in alignment during construction.
5. The use of rings without proper proportion of radial bars is not desirable. This is evident by comparing specimens 5 and 6 with specimen 3. In practice this ratio is dependent upon other items; however, not less than 20 per cent of the total required area should be placed in radials, to give good stiffness.
6. The circles must be proportioned in such a way that the diameter of the circle shall extend several inches beyond the points where the reinforcement is required.
7. The lap of 50 diameters of plain bar used in the tests proved to be sufficient to develop the elastic limit of the bar. In no case did failure occur at the splice.
8. Stresses are equally resisted by all the rings (except when the rings are not properly placed), and the elastic limit in radials and rings is reached at about the same time.
9. The effectiveness of the compressive reinforcement is evident from the fact that even for the large load carried by specimen 4 no compressive weakness was manifested.
10. Specimens reinforced with straight bars built on the two-way and four-way systems (specimens 7 and 8) failed under smaller actual bending moment (figured on the basis of load times the radial distance from the column head, which was used for all specimens) than the moment of resistance of the steel. This can be explained by the fact that the moment acts in all directions around the circumference radially and circumferentially, while the moment of resistance acts only in the direction of the bands. Therefore only the components of the moment of resistance were effective in resisting the bending moment.
11. Radial and circumferential reinforcement is more effective than straight bars. By comparing the effectiveness of steel of equal weights from the table, it is evident that radial reinforcement is more than twice as effective as the reinforcement consisting of straight bands.



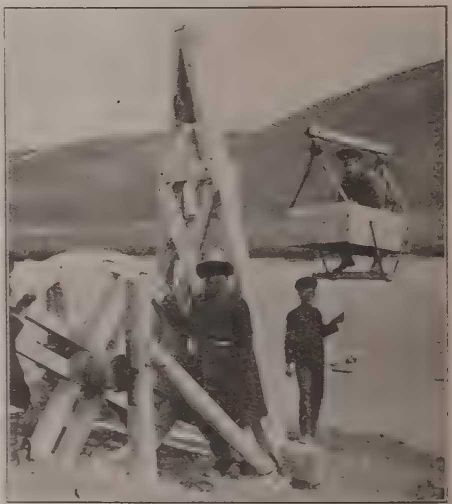
TOP OF SPECIMEN 2 AFTER TESTING

These tests were made by the writer under the supervision of Sanford E. Thompson, consulting engineer, Boston. The specimens were built under the direction of H. M. Davis, engineer, and readings were made by K. A. Funk and A. H. Haggart from Mr. Thompson's office, and T. A. Shea on behalf of the writer. The work was supervised by both Mr. Thompson and the writer.

Turkestan Gaging Station Has a Curious Winch

THE gaging station illustrated in the accompanying view represents a combination of primitive and modern equipment. The modern features are shown by the use of a Gurley current meter, Price pattern, while the winch is a relic of early days. Instead of being fitted with lever handles attached to the drum shaft, as is customary in this country, the winch is operated by means of pegs on a large wheel, as is clearly shown in the photographic view.

The station is operated by the hydrographic service of the Imperial Russian Government, and the photograph was supplied to the Engineering Record by W. & L. E. Gurley, of Troy, N. Y., manufacturers of the current meter referred to.



WINCH IS OPERATED THROUGH PEGS ON THE LARGE WHEEL

Convicts Build Mountain Highways in California

Two Camps of 61 Men Each Have Been at Work Since Last September—Four Attempted Escapes Were Frustrated by Fellow Convicts

THE California Highway Commission has recently established two road construction camps in the northern part of the state in which convict labor is employed exclusively. The camps are being operated under the supervision of men selected to direct the work, because they had the success of the plans at heart and desired to demonstrate to the public that when properly organized and directed convict labor offers a practicable and economical method of obtaining good results in the construction of roads.

Two Camps Established

The first group of forty-seven convicts left the state prison at San Quentin on Sept. 20, 1915, and was followed later by fourteen men, thus bringing the total number in camp A to sixty-one. The second camp was established Nov. 8, 1915, starting with thirty-four men, which number was later increased by twenty-seven more, making a total of sixty-one at camp B. Up to the present time the men in these camps have been continuously employed on road construction, and while it may be too early to draw final conclusions, state authorities feel that the results thus far indicate that the plan will prove eminently successful.

The camps are located on the south fork of the Eel River in northern Mendocino County, camp B being about 13 miles from the Humboldt County line and camp A 5 miles farther south. Both camps are accessible by wagon roads from the coast, distant 24 miles, by which route all supplies and equipment have to come in. The camps were established about midway in the 33-mile section proposed to be built by convict labor, and which includes the roughest portion of the main trunk highway to be built between San Francisco and Eureka. This location was chosen as being the only point where conditions were favorable for advancing the work on either side of the camps. At the same time it would be possible to work on a part of the line where the rock formation offers greatest advantage for winter construction.

Camp Organization

The highway commission is represented in the camps by the superintendent, who is an engineer experienced in highway construction and who directs the organization. He is assisted at each camp by a foreman and a transitman with one or two rodmen. The prison authorities are represented by three guards at each camp, one of whom has direct charge of the conduct and discipline of the men and who also has, under the direction of the superintendent, charge of the commissary and messhouse. The other two guards act as sub-foremen, and when on the work are under the direction of the foreman. Cooks, blacksmiths, powder men and teamsters are all convicts, so that other than foremen there is no free labor regularly resident in the camp. Under the honor system the men are not guarded, and the term "guard" in connection with the camp organization is a misnomer.

The California convict labor bill provides that the state board of prison directors shall have full jurisdiction at all times over the discipline and control of the convicts employed on state roads. There are no firearms in evidence either in the camps or on the work, and the men are treated much the same as free labor. Punishment for any infringement of rules is only administered by returning the men to the prison and withdrawing the additional good-time allowance provided by law, which is one day for each two calendar days that the convict is employed on road work.

An Escape Foiled

No precautions are taken against escapes, and the men, outside of working hours and on holidays, enjoy almost absolute freedom. This privilege has resulted so far in four unsuccessful attempts to escape. The circumstances of a recent capture indicate the spirit in the camp. Two of the convicts got on the trail of two runaways and after a strenuous chase in the snow over a rugged country overtook them at a cattle ranch. After pleading with them without avail to return to the camp, and the rancher being at a loss to know whether or not all four had escaped from the camp, at the instigation of the trusties they were all held by the rancher at the point of a shotgun until the guards arrived.

At camp A the men are housed in 18 x 30-ft. tents provided with wood floors and each occupied by from 12 to 14 men. At camp B a frame building 18 x 21 ft. in plan covered with Malthoid roofing and lined with building paper is provided for each 8 men. All bunkhouses are provided with an iron cot, mattress, blankets and pillow and an iron camp chair. A camp reading room is kept equipped with books and magazines as well as checkers and dominoes, but no playing cards.

The commissary equipment is first class throughout, and an ample supply of good wholesome food is served in an airy and well-lighted messroom. The equipment at each camp includes a bathroom with hot and cold water, four showers, and a laundry. Each person washes and mends his own clothes, and one of the convicts is occasionally detailed for shoe repairing.

The work was purposely laid out with reference to weather conditions and geological formation so as to preclude the economical use of teams, limiting the work to hand implements. Only one team is employed at each camp, and this is detailed to the work of clearing, hauling firewood, and distributing culvert material. The convicts clear the right-of-way, install culverts, and build the road to completion.

Experiment Considered Successful

The convicts are of various nationalities, from all grades of society. Their sentences vary from a few months to life terms. Crimes range from petty larceny to murder, the average sentence being about 12 years; those serving life terms are men whom the prison directors are considering for parole.

The energetic spirit which highway engineers report as prevailing in the camps is taken as evidence that the effort to harmonize all of these different natures into an efficient force has proved successful. Extreme weather conditions characteristic of the locality were expected, and a decision was made in advance that the situation demanded a firm stand for six days' work in seven, rain or shine. Suitable clothing was provided, and this program has been successfully adhered to.

Since the installation of the camps 19 men have been returned to the prison, 5 were malcontents and agitators, 4 attempted to escape, 7 became sick, and 3 were paroled. As a result of experience in these camps, it is believed that the proper application of reward for good conduct and diligence, and punishment for misbehavior and indolence, bear a very important relation to the successful administration of the organization.

Costs

The cost data obtained up to date are not considered a fair criterion of the efficiency of the system. Men accustomed to the inaction of prison life are more or less unused to manual labor, and in this case have not yet had time to become inured to the rigorous camp life. In addition to this, the cost of building the camps and transporting men to this remote locality makes a showing not comparable with that ultimately expected; however, including these additional costs, the camp records to date show the following apportionment:

Cost Per Convict Per Day

Subsistence	$0.69
Housing	.22
Transportation	.102
Clothes and other allowances (including hospital treatment)	.24
Guarding	.062
Total	$1.314

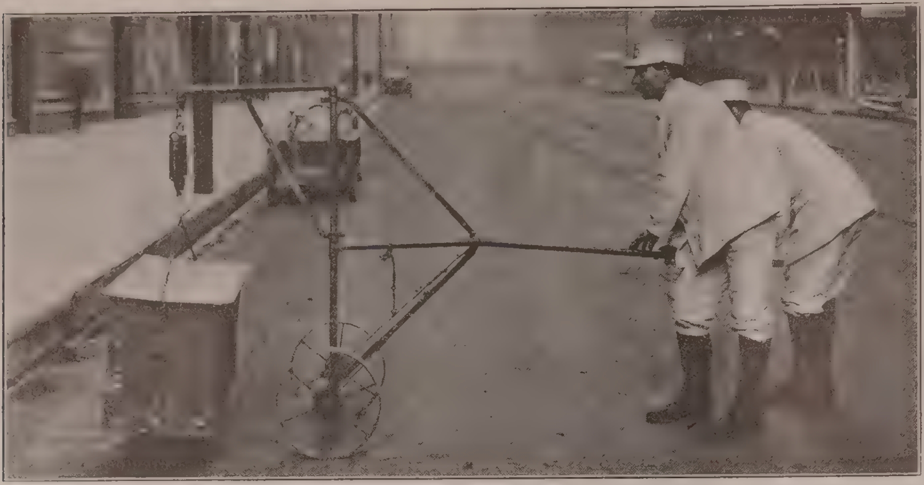
This total figure works out as the equivalent of 43 cents per cubic yard of earth and rock excavation involved in the work. This would include all clearing and grubbing incidental thereto.

The work at the convict camps has been under the supervision of F. A. Kittredge, who reported through F. G. Somner, division engineer, to A. B. Fletcher, chief engineer of the California Highway Commission.

Peak Flood Run-Off Figures Given for Southern California

DURING the storm which culminated in southern California on Jan. 27, and which came as a record rainfall on drainage areas already saturated, the maximum flow ever recorded was reported from the Sweetwater, San Diego and San Luis Rey Rivers. These streams have their sources in the hills between the Imperial valley and the coast, where considerable snow falls annually and therefore subjects the streams to the possibility of the heavy run-off that comes from warm rains on snow-covered areas. The rainfall ranges from about 9 in. on the coast to more than 60 in. in the mountains.

On Jan. 27 the run-off from the 100-sq. mile basin above Sweetwater dam was estimated to have averaged 33,000 sec.-ft. for four hours, or 330 sec.-ft. per square mile. On the San Luis Rey River a gaging taken near the mouth at 5.30 p. m., Jan. 27, showed the flow to be 55,000 sec.-ft. from the 578-sq. mile drainage area, or 95 sec.-ft. per square mile. However, at the peak of the flood the water was 2 ft. higher than when the last gaging was taken. On the San Diego River the flow at the peak of the flood was 29,800 sec.-ft. from a drainage area of 434 sq. miles, or 68.6 sec.-ft. per square mile. In the latter case the peak occurred less than twenty-four hours after the flow was only 2000 sec.-ft.



WEIGHT AND VOLUME OF REFUSE RECORDED FREQUENTLY

Cleanliness Standard for Street Cleaning for First Time

Richard T. Fox, General Manager, Chicago Citizens' Street Cleaning Bureau, Permits No Dirt to Lie on Streets More than 15 Minutes

THAT a standard of cleanliness for street cleaning by the intensive method may be expressed in definite terms was proved for the first time in a paper presented recently to the Western Society of Engineers by Richard T. Fox, general manager of the Citizens' Street Cleaning Bureau of Chicago. In the 120,000-sq. yd. area of streets in the shopping district, supervised by the bureau, the standard of cleanliness permits no dirt on the street beyond a maximum of 15 min. On a typical route, excluding the first hour of work when the force is cleaning up the night's accumulation and the noon hour, 48 per cent of the total pickups were made within 1 min., 72 per cent in 2 min., 94 per cent in 6 min. and 97 per cent in 10 min. Tests made on all the routes cleaned by the bureau show that it is easily possible to collect every deposit within the 15-min. limit. On the average, dirt dropped will be picked up within 2.7 min. The following abstract has been prepared from Mr. Fox's paper:

CLEANING PROBLEM ANALYZED

In order to make clear what is meant by our standard of cleanliness it is necessary to consider the character and distribution of street refuse and the method of removing it from the streets. The process of cleaning the streets is carried out in two operations—first, the collection of the refuse from the streets; second, the removal of the material to the points of disposal. The latter is a simple transportation problem, involving the hauling of certain quantities which vary somewhat from day to day from definite points, definite distances to the points of disposal. The factors affecting the amount of work a cart, wagon, motor vehicle or other unit can do per day can be measured and a definite standard of work set up. The quantity and quality of work can be readily checked. The collection of the refuse from the streets presents a different problem, the solution of which is more involved as to a determination of standards of work and the quantity and quality of work.

STREET REFUSE IS IN TWO FORMS

Refuse appears on the street in two forms; as fragments of various sizes and as fine dust. For convenience the former will be referred to hereafter as dirt or refuse and the latter as dust or residual dust. If a street is given anything like the daily attention it requires the dirt appearing on its surface through the day will lie in detached deposits here and there with clean spaces of pavement between them. It is not necessary then to clean the entire street, but simply to remove the individual deposits of dirt. The demands of a proper removal of this refuse from the street surface requires the observance of two principles: First, that the dirt be picked up at or as near as possible to its point of origin in the street; second, that the refuse be collected as near the time of origin as possible. If the dirt is thoroughly collected just where it lies and while it is still moist no dust will be raised during the operation.

FINE DUST AN ANNOYANCE

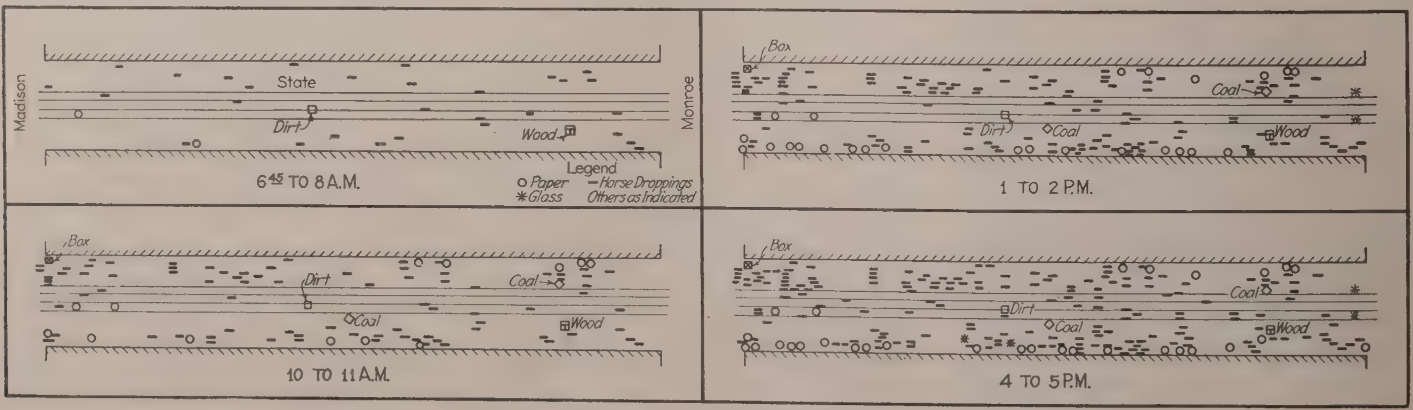
If these two principles are vigorously and intelligently applied through the day there will remain on the street after the day's work is complete a very fine dust, the quantity of which will depend on the fineness of the broom used in the day's work and the thoroughness of the cleaning. This residual dust is the greatest annoyance and nuisance with which the street-cleaning forces have to contend, and as a medium for disseminating disease germs it is a menace to health. It is very difficult to manage, because it is appearing every moment on the street from such sources as the thousands of chimneys, the roofs of buildings, the fine sand used by the street railway companies, the wear from pavements, sidewalks, wheels, street-car rails, etc., all of which are without the control of the street-cleaning officials.

HOW DUST IS REMOVED

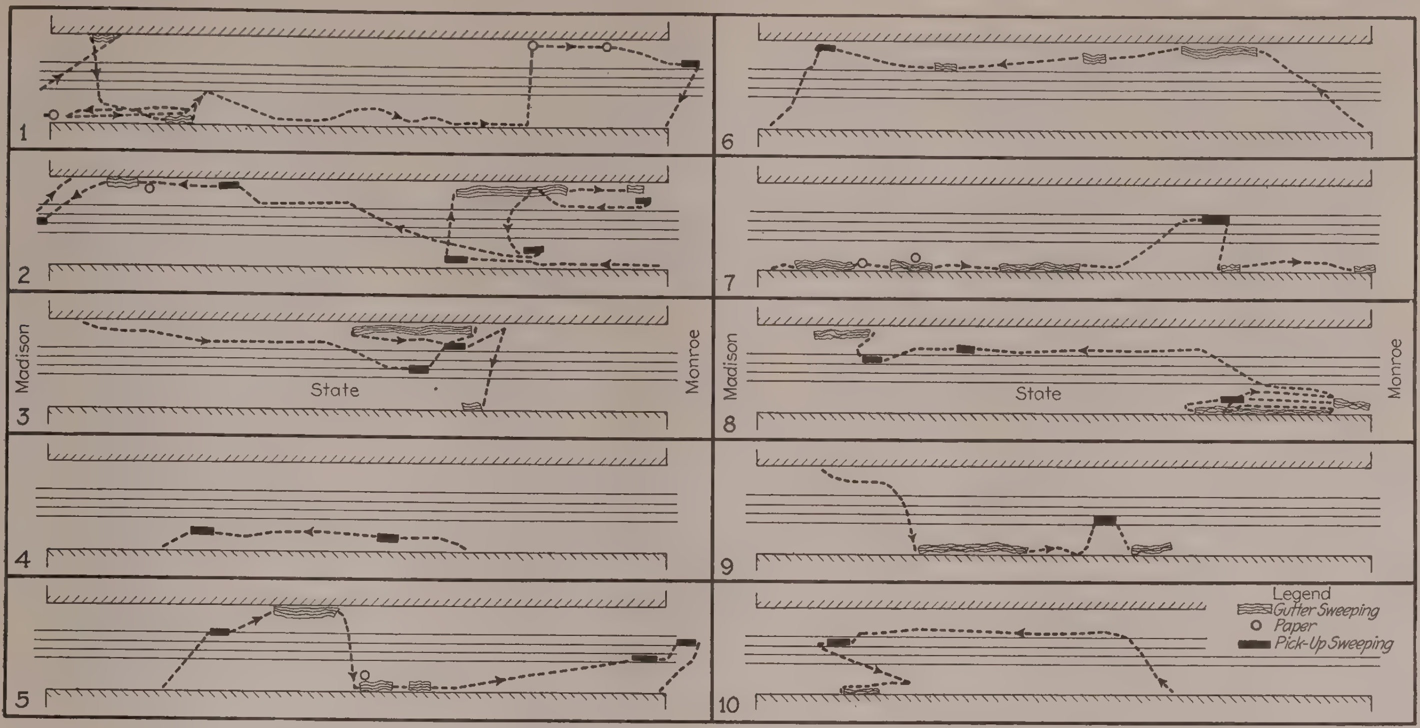
Any system of street cleaning, to be effective, must provide every means possible, such as artificial sprinkling, flushing the streets and even scrubbing them, to combat the evil of fine dust. Mr. Fox finds the most effective method and means of routing the dust is to flush the streets at night with a motor-driven machine carrying a large tank from which the water is forced out under any desired pressure up to 70 lb. by a pump driven from the flywheel of the motor. Following this operation the sidewalks are flushed and hand-squeegeed to remove any dust from the roadway or sidewalk collected in low places there. When the weather does not permit of flushing the noticeable deposits of dust are collected by the men cleaning sidewalks. These men are provided with horsehair brooms, by careful use of which they can collect the dust without causing a nuisance by setting it astir.

QUANTITY OF WORK

The quantity of work—the square yards of street pavement a man can clean daily—will depend not only on the refuse accumulations per 1000 sq. yd. per twenty-four hours; the kind of pavement—whether rough blocks with open joints, or a continuously smooth surface, condition of pavement—whether in good repair or not, but also on the quality of work—whether thor-



VISUALIZATION OF CUMULATIVE INCREASE OF REFUSE ON STATE STREET FROM HOUR TO HOUR IF STREET IS UNSWEPT



ROUTE OF SWEEPER IN COLLECTING REFUSE ON EACH OF TEN TRIPS ON STATE STREET, CHICAGO, FROM 1 TO 2 P. M.

Trip 1, 1.00-1.12; trip 2, 1.12-1.19; trip 3, 1.19-1.23; trip 4, 1.23-1.27; trip 5, 1.27-1.33; trip 6, 1.33-1.38; trip 7, 1.38-1.44; trip 8, 1.44-1.53; trip 9, 1.53-1.57; trip 10, 1.57-2.00.

ough or not—and on the standard of cleanliness. The first three factors are definite matters of fact. The remaining two have so far been considered questions of opinion, and have not to Mr. Fox's knowledge been defined.

The quality of work is a very important consideration, for a street surface not thoroughly cleaned cannot be called clean. If the horse droppings are carelessly picked up, if the dirt in the crevices and depressions of the pavements is not thoroughly removed; if, in fact, every bit of detachable refuse is not collected, the street has been merely brushed over, and the condition of the pavement falls far short of the aims of proper and sanitary street cleaning.

How Quality of Work Is Measured

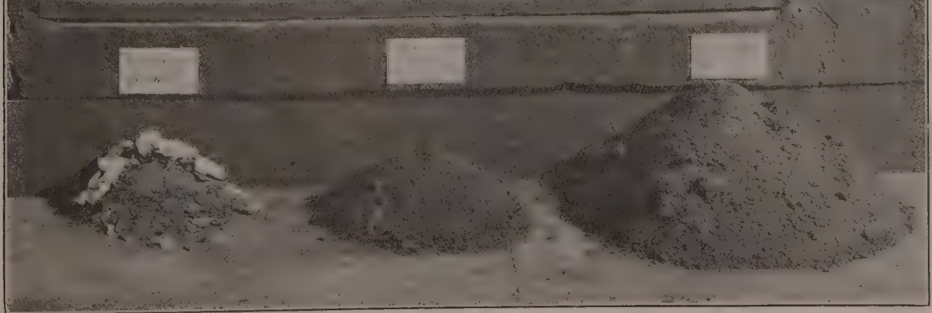
Theoretically, the measure of the quality of work is the quantity of material remaining on the streets after the day's work is complete, less any accumulations after the beginning of the sweeper's last trip over the street. But, as pointed out, there is always on the street at the end of a day's work a certain quantity of fine dust which cannot be collected by the means at the sweeper's disposal. This quantity varies from day to day, which is due to a number of factors not under the control of the sweeper. Therefore, unless there is a very noticeable increase in the residual dust, it is difficult to determine whether or not the sweeper is at fault.

Furthermore, there might be enough undigested portions of hay, oats, and other feed, and bits of paper, together with matches, cigar or cigarette butts, and other noticeable odds and ends, scattered over the street to give it an untidy and an unsightly appearance; and yet the total quantity of these would affect but little the amount of residual dust on the street.

Practically, then, this test for quality is not as a rule feasible. The practical day-to-day determination of this element of the work is by the eye of trained and experienced inspectors, who are alert and observant.

What Is a Standard of Cleanliness?

When we say a street is clean, what do we mean? In other words, what is a clean street? Absolute cleanliness, the ideal condition, means that a street must be continuously free of dirt and dust. This condition can be maintained as far as the heavier fragments of street refuse are concerned, but the cost would be prohibitive. Moreover, it is not necessary, for this dirt is not objectionable if removed before it dries out or is scattered and ground into the pavement by traffic. The length of time it can be left on the street will depend upon the amount of the twenty-four-hour accumulation per 1000 sq. yd. of street surface; or, in other words, on the volume and kind of traffic. The residual dust from one or the other of many sources, although it may be hardly perceptible, will always lie on the street. Therefore, absolute cleanliness is an impossibility and will continue to be so until the sources of dust beyond the control of the street cleaner are eliminated. The length of time any refuse other than dust is permitted to remain on the street will determine the standard of cleanliness for that street.



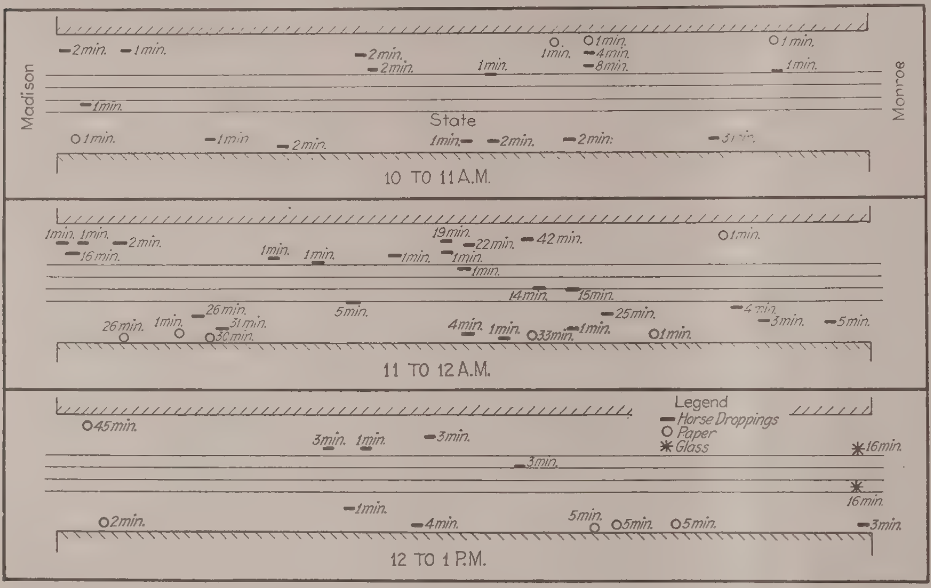
WHERE DUST COLLECTED AT THE END OF THE DAY IS FOUND

A standard of cleanliness, then, is an arbitrary matter, but it can be made definite for certain conditions of traffic, etc., by specifying the length of time any refuse other than fine dust can remain on the street. In order to make this point clear Mr. Fox referred to the conduct of the work of the Citizens' Street Cleaning Bureau, where he has developed, in following closely the hand-collection principles, what may be called the intensive method of street cleaning. The aim of this method is not only to clean a street thoroughly, but to keep it continuously clean throughout the working day.

Pickups as Fast as Dirt Falls

The street sweepers are assigned a definite length of street, called a route, to care for as in the "patrol" or "block" system of street cleaning. The men are required to clean thoroughly their routes in the first hour of work in the morning, and thereafter to keep the refuse picked up practically as fast as it reaches the pavement. In other words, the work is not allowed to accumulate, but is taken care of as it presents itself. It is apparent that to do this the number of cleanings or trips over the route formerly given must be greatly increased. This increase is expressed in the statement that the standard of work under the "block" system is based on a certain number of cleanings per day, while the intensive method requires a certain number of cleanings per hour. The advantage gained in the latter method is that for the same street areas cleaned and the same amount of dirt collected the length of time the dirt lies in the street is greatly decreased by reason of the added number of cleanings, and therefore a much higher standard of cleanliness is obtained.

The explanation of the ability of the sweeper to increase so greatly the frequency of cleaning is apparent from a study of charts which Mr. Fox plotted from records of the location, time of deposit and time of collection of every bit of dirt appearing on a particular route. One of the charts was made up of ten diagrams, one for each hour of the day. Each successive diagram after 8 a. m. includes all the deposits of dirt for the preceding hours. The chart, therefore, is a visualization of the refuse accumulated on the route at the end of each hour, assuming that the street is not swept nor the dirt disturbed. Let us say that the route is swept once per day, the dirt to be collected is represented in the last diagram of the chart from 4 to 5 p. m.



PLACE OF REFUSE ACCUMULATION AND TIME ELAPSING BEFORE COLLECTION FOR DIFFERENT HOURS OF THE DAY ON STATE STREET, CHICAGO

The actual condition of the refuse would not be as indicated; it would not be in individual deposits. The sweeper would find it spread over the entire street and adhered to the pavement by the action of hours of heavy traffic, and he would be compelled laboriously to sweep with a hand broom every square foot of the surface to clean it thoroughly. The distance walked by the sweeper in the course of the day's work would be at least 4.3 miles, which means that he must sweep a like distance, as this act is continuous through the day.

If it is assumed that the route is cleaned once each hour the accumulation per hour may be indicated on a chart representing the refuse actually collected from the route. The deposits of dirt would be shown with clean spaces of pavement between them, and this will be the actual condition, for the dirt will be scattered by traffic but little when the route is cleaned so frequently. The sweeper can now use, in addition to his broom, a pan scraper, which permits of more rapid and easier work than with a broom alone; and, as he can collect each deposit of dirt where it lies without cleaning the entire street, a trip over the route is rapidly made. The distance now walked is a minimum of 6 miles per day of ten hours. Therefore, the distance walked has increased and the labor of sweeping has been lessened.

WORK SHIFTED FROM ARMS TO LEGS

Now, if the route is swept seven times in an hour, as shown in one of the charts, which is an intensive study of the 1 to 2 p. m. condition, it will be seen that on that one trip no dirt was collected at all and that the greatest number of pickups per trip for the hour was six. Therefore the sweeper is able to clean the street about as fast as he can walk, and the work is accordingly much less laborious than in either of the other instances. The route in question was swept ninety times, the sweeper walking a minimum distance of 8 miles in ten hours. That is to say, the sweeper has shifted a considerable part of his daily burden from his arms to his legs. The total physical effort is no greater than in the other instances.

The streets cleaned by the Citizens' Street Cleaning Bureau produce from 5 to 8 cu. ft. of street refuse per 1000 sq. yd. per twenty-four hours. On streets of lighter traffic and therefore accumulating less dirt the street areas or routes allotted per man would naturally be increased. In such cases if the streets are the same width a sweeper would have a greater length of street to traverse, and would accordingly make less trips per day. The length of time elapsing before collection would be increased. In other words, another time standard must be established for the new conditions.

LONG CLEAN PERIODS

A study of one of the charts indicated that there are periods totaling twenty-one minutes in the hour from 1 to 2 p. m. in which the street in question was entirely free of dirt. These clean periods average three and one-half hours per day for the entire district cleaned.

While the standard of cleanliness of the bureau is defined and can be readily checked within close limits, and is checked from time to time, the day-to-day determination of this factor is by the eye of the foreman. The standard of cleanliness is so fixed in the minds of the foremen that they can tell at a glance whether or not a sweeper is abreast of his work.

W. B. Parsons Explains Engineer Reserve Bill

Proposal to Give Commissions as High as Rank of Major to Technical Men with Proper Military Training

"HAD the Spanish war really been serious there would have been no engineering troops for many months to do the things that would have been urgently and immediately demanded." Using this as the text of his address, William Barclay Parsons told the members of the Boston Society of Civil Engineers and the local sections of the national societies of electrical and mechanical engineers at their annual banquet at the Boston City Club last week, of the need for technically trained men in the plan for national defense and outlined the progress made by the joint committee of the five national engineering bodies, of which he is chairman, in securing legislation creating an engineer officers' reserve corps.

This legislation, with amendments already proposed by the General Staff of the Army, provides for the giving of commissions to men who, by examination or otherwise as determined by the President, have demonstrated their fitness. These commissions, Mr. Parsons explained, are to be for all grades up to and including the rank of major; they are for five years, renewable at the discretion of the Secretary of War, which permits the elimination without friction of human deadwood. At times of war these officers would be subject to call precisely the same as any other officer of the army, and in times of peace they would be required to serve for two weeks each year, or longer with the officer's consent. There will be no pay except for the short period of duty.

FRONTIERS NEED PROTECTION

Our land frontiers, Mr. Parsons pointed out, are unprotected, and our coasts are defended only at isolated spots. If war ever should be declared we would have to place mines in all our harbors; throw up earthworks along our coasts and secondary lines to provide for reserve defense in case a foothold on the shores should be forced; lay the foundations in concrete for heavy guns; build branch railways to isolated points on the coasts, for such points without transportation facilities would be the most inviting for attack; build highways capable of standing up against heavy motor traffic, and maintain and repair both the railways and the highways. It would also be necessary to string telegraph and telephone lines and install wireless stations; make camps for large armies, with water supply, sewers and lights. These things and many others would have to be done, not at one or two places but practically along our whole seaboards, for we could not tell where the enemy would strike.

Should the war be one of offense, as for instance to maintain the Monroe Doctrine, all these things would have to be done at home, to prevent a diverting home thrust, and in addition we would have to send an overseas expeditionary force to construct suitable landing places for our troops in some Central or South American country already held by an enemy, and build and maintain elaborate lines of transportation, besides carrying out military engineering works on a large scale.

We all know, said Mr. Parsons, the impossibility of selecting men during the initial excitement in the stress of war, but if they are chosen carefully in times of peace and then classified according to experience and given some training the War Department will have at hand a body of experienced engineers who could be at once assigned to special duties according to their ability and training, and thus reinforce and supplement the Corps of Engineers.

Air Diffusers Tested at Milwaukee Sewage Plant

T. Chalkley Hatton, Chief Engineer, Gives Results of Experiments on Activated Sludge Process Details

In its experiments to determine the best method of securing a uniform diffusion of air for sewage treatment by the activated sludge process the Milwaukee Sewerage Commission has conducted exhaustive tests of various materials, as a result of which preference is given to a quartz sand plate baked until it is hard and strong. It is felt by the commission, however, that the best method of air diffusion has not yet been determined. The experiments have shown that there are three factors of special importance to be considered in choosing a diffuser agent. As set forth by T. Chalkley Hatton, the commission's chief engineer, in his paper presented Jan. 27 before the joint convention of the Illinois section of the American Waterworks Association and the Illinois Society of Engineers and Surveyors these three factors are: First, the smallest air bubbles produce the greatest efficiency. Second, greater density of the diffusing substance increases the frictional losses, and hence the cost. Third, the tendency to absorb and retain sludge, or to permit it to reach the underneath surface of the diffuser, tends to reduce the efficiency of the diffuser and allows sludge to precipitate on the top surface of the diffuser. Extracts from Mr. Hatton's paper are given below:

Diffusing Agents Tested

The open air jet, Mr. Hatton states, reduces the loss of air pressure, but reduces its efficiency, owing to the size of the air bubbles produced. This objection may be overcome by reducing the size of the orifice. With an orifice 1/1000 in. bubbles 1/32 in. in diameter would be produced, which is below what is termed the critical size. It is problematical whether such small orifices would be kept free due to the small particles of solid matter carried along with the air. Another objection to the open jet is its tendency to clog the air feed pipes with sludge drawn into the pipe when the air is shut off for any reason.

Monel metal cloth has been tried out only for about a month, and proved quite satisfactory. Although much more porous than the filtros plate, it produced smaller bubbles, due probably to the fact that the surface of the cloth was smooth and the air, while building the bubble, could not adhere to the surface as it does to the rough granular surface of the filtros plate.

Kisselghur was tried. It gave the smallest bubbles of any other agent, but the initial frictional loss sustained in getting the air through a plate ½ in. thick was 20 lb., which made this diffuser impracticable, owing to cost.

The filtros plate, if furnished of uniform porosity, has given the most satisfactory results, according to Mr. Hatton, but it has a few characteristics which should be realized. This material is manufactured by the General Filtration Company, of Rochester, N. Y., and was designed to filter water rather than sewage. It is made in plates 12 in. square by 1½ in. thick, and is composed of quartz sand, supposed to be of a uniform coefficient according to the porosity of plate required, baked until it is quite hard and strong. It is produced in several different grades, which are classified in conformity with the volume of air which each plate will pass, when dry, per minute under a pressure due to 2 in. of water. These classes run from 0.5 to 12 cu. ft. of air per minute.

The accompanying table gives the comparison of results obtained by using filtros, air jet and monel metal cloth.

Comparison of Air-Diffusing Materials

Diffuser	Period, 1915	Pressure of mercury in pounds	Vol. of air used in cu. ft. per gal.	Per cent of bacteria removed	Nitrate formed in P.P.M.	Stability of effluent in hours
Filtros plate	June 1 to Aug. 12..............	4.3	2.06	91	3.4	78
Air jet	June 1 to Aug. 12..............	3.5	1.94	91	2.2	52
Filtros plate	Nov. 18 to Dec. 7..............	4.6	1.71	90	0.3	113
Monel metal	Nov. 18 to Dec. 7..............	3.0	1.71	80	0.2	63

It is of the greatest importance that the agent used shall diffuse the air uniformly per cubic foot of liquor. Therefore great care should be taken in getting a diffuser of uniform porosity. So far this has not been possible with the filtros plate. Out of 780 plates tested for the new 2,000,000-gal. plant at Milwaukee, where the specifications called for a plate which would pass 2 cu. ft. of air per minute under a 2-in. water pressure and allow a 5-per cent variation either way, 35 per cent of the plates received were rejected, and only 27 per cent came within the strict terms of the specifications. The manufacturers, however, have recognized the necessity for exercising greater care, and are equipped to furnish more uniform plates, and to test them before shipment.

Tests made with the plates used showed that when wet the initial loss of pressure due to passing the air through the plate under 5-lb. pressure was ¾ lb., and for every cubic foot of air per minute per square foot of surface passing the plate there was an additional loss of ¼ lb.

Reducing Frictional Loss

There are two ways of overcoming this great frictional loss, and the factor is an important one to consider in large plants. One is by reducing the thickness of plate to about ½ in. and reinforcing it with wire similar to window glass reinforcement, and the other is by soaking the plate, before use, in a mixture of paraffin and benezine, blowing with air until the paraffin appears at the surface of the plate. This establishes fine pores through the plate, which are coated with a non-absorbent, permitting the air to pass with the least friction and the paraffin impels the water so that the plate does not become waterlogged.

At Milwaukee filtros plates have been operated for nine months under all sorts of conditions, and there has been no difficulty in keeping them from absorbing the solids in the sewage, or becoming clogged on the underneath surface. It may be possible for the pores to become filled in time with bacterial growths, which may be removed by forcing heated air through them. It is necessary, however, to filter the air before delivering it to the plate to prevent the dust and dirt from reaching it. This is done by passing the air through a filter composed of excelsior built into the feed line. The critical diameter for air bubbles is ⅛ in. Below this size the efficiency increases very rapidly, and the reverse is true for bubbles over this size.

Functions of Activated Sludge

Activated sludge accomplishes four principal functions: Clarification of the liquor; removal of the putrescible organic matter; reduction of bacteria; and, finally, if the process be continued for a sufficient period, the ammoniacal compounds are oxidized into nitrates. Therefore one of the first steps in designing a plant in which this process is to be employed is to determine the degree of purification required, following which the question arises as to efficiency, volume of air required, period of application and volume of activated sludge necessary to be kept in retention with the raw liquor.

Milwaukee's Problem

The problem in Milwaukee embraces the clarification of the liquor, securing an effluent stable for five days, the reduction of the suspended matters 90 per cent, and 95 per cent removal of bacteria at 20 deg. C. With the continuous flow tank Mr. Hatton has secured this average effluent for months by using 1.75 cu. ft. of air per gallon of sewage with 4-hr. aeration, 20 per cent activated sludge and from 10 to 15 min. sedimentation period. Basing these results upon the operation of a 50,000,000-gal. plant, the estimated cost will be $4.38 per 1,000,000 gal., including all overhead and boiler room charges, but excluding engine room and plant attendance, and the cost of disposing of the sludge.

The Milwaukee commission has found no difference in the results obtained by carrying out the process either by the fill-and-draw or continuous flow methods, considering volume of air applied per gallon, cost of aeration and volume of activated sludge required. But measured in terms of cost of construction and operation the "continuous flow" is the superior method. With a wide variation in strength of liquor and rate of flow a more uniform standard of effluent can be obtained from the fill-and-draw method, because it is susceptible of better control, which is true of all fill-and-draw processes.

Sand Spreaders for sanding pavements to prevent skidding and slipping in damp weather are being used very successfully, it is reported, in San Francisco and Portland, Ore. The quantity of sand distributed can be easily kept below the quantity that would clog storm drains, at the same time that it is ample to make the pavement safe. The spreader, which is of the rotary, adjustable type, can make a round trip of fourteen blocks per hour when drawn by horses. In emergencies it is drawn as a trailer by an auto truck.

Plan for Lehigh Valley Station at Buffalo Places Train Shed Columns Between Tracks

Designs for a Nine-Track Shed Make Special Provisions for Future Addition of One More Track—Roof Lights Are of Unusual Type

A MODIFICATION has been made in the new train shed for the Lehigh Valley Railroad at Buffalo, N. Y., by locating the columns on the center line between tracks instead of placing them on the center line of the passenger platforms, as has been done in the other eleven Bush train sheds previously built in this country and Canada. This arrangement changes the relative position of smoke ducts and skylights to columns and modifies some details of the steel frame. The plans and specifications call for about 50,000 sq. ft. of the Keppler system of roof lights, adopted for greater permanence, minimum cost of maintenance and exceptional lighting value. The plans also provide for the future addition of one more track by increasing the width of the shed.

Reasons for Modified Design

The adoption of the design with columns between tracks resulted from the desire on the part of the railroad company to keep clear for pedestrians and trucking purposes the comparatively narrow passenger platforms, 14 ft. 2⅜ in. wide. The resulting modifications in the details of the structural design of this Bush train shed will be apparent by comparing the sections here shown with those in the Engineering Record of Jan. 4, 1913, page 6, describing the twenty-track Bush shed at Jersey City, N. J., and the seven-track Bush shed at Ottawa, Canada.

Fixing the General Layout

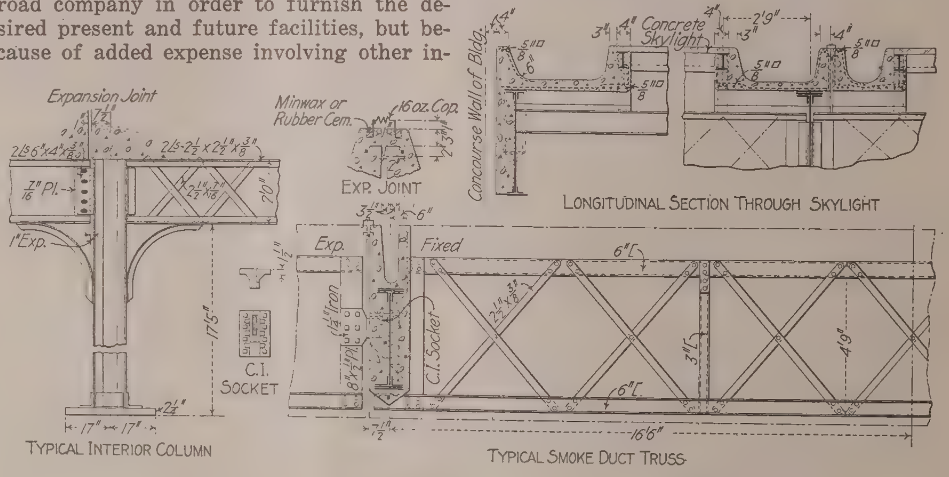
Owing to the fact that the existing facilities at the old Lehigh Valley Depot in Buffalo had become inadequate, the railroad recently began the construction of a new passenger station at the corner of Main and Scott Streets, designed by K. M. Murchison, architect, of New York City. It will be a four-story structure finished in classic style, using Indiana limestone with granite base and terra cotta trimmings. A ramp leads from this station to a tunnel under Washington Street, and a second short ramp leads up to the headhouse and concourse of the new train shed. This headhouse, 100 x 181 ft., is of gray brick with terra cotta trimmings, is two stories high, and includes the express, mail and baggage rooms and full-length concourse on the first floor, and the immigrant waiting rooms and employees quarters on the second floor.

The general layout for the steel-frame shed was determined by the total lot width of 195 ft. from Scott Street to the property line on the north, and the available length of about 843 ft. for straight tracks from the headhouse to the freight tracks connecting with the new freight station on the south side of Scott Street. Allowing for a width of 8 in. for the columns between tracks, the clearance requirements fixed the minimum track spacing at 14 ft. 8 in. Ten train shed tracks were planned by the railroad company in order to furnish the desired present and future facilities, but because of added expense involving other interests nine tracks only are now to be completed.

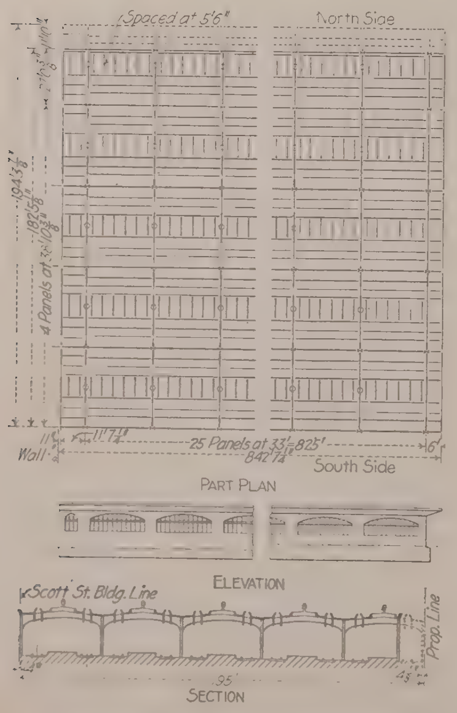
The north side columns and details are unusual, because the old Hamburg sewer, located along the northerly property line, interferes with the column foundations. The necessity for strengthening the sewer to carry the most northerly track and columns led to the decision to eliminate the tenth track in the shed for the present. The available width and required number of tracks and clearances thus fixed the width of platforms at 14 ft. 2⅜ in., allowing 5 ft. clearance from edge of platform to center of track. The panel length of 33 ft. between column centers was selected as the economical unit, considering cost of foundation piers of concrete, with piles in the northerly bays where filled ground is encountered at the former site of the old Hamburg Canal.

Typical Column and Girder Details

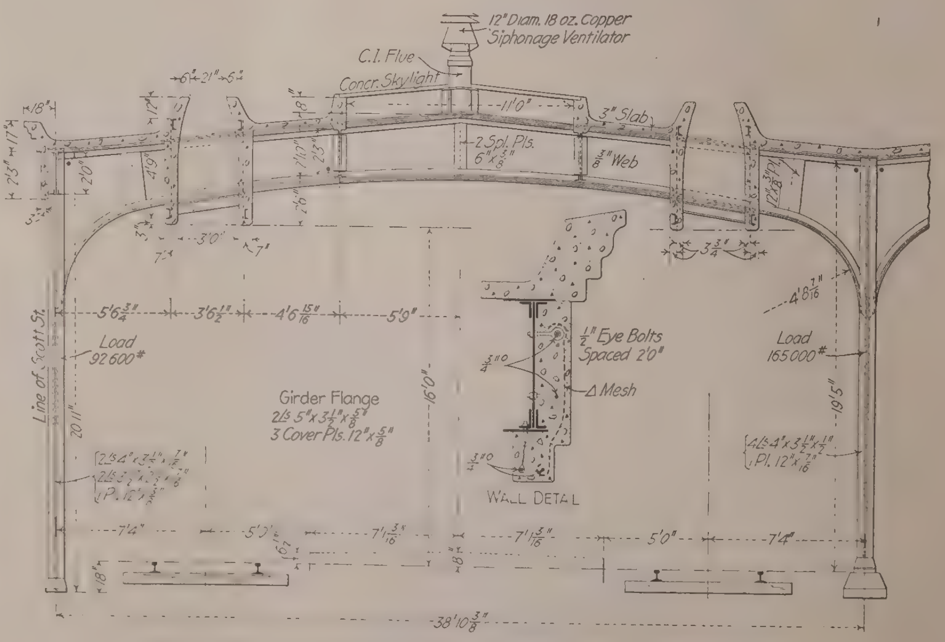
It will be seen by the accompanying cross-section that the columns are of built-up I-section with the webs parallel to the tracks to give maximum clearance. The curved girders are field-riveted to the columns, the flange material being bent and riveted up in the shop. The required 16-ft. clearance from top of rail to under side of smoke ducts, close to the low point of the shed, makes the total height for this de-



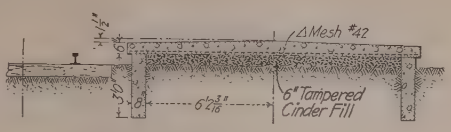
DETAILS OF TYPICAL COLUMN AND SMOKE DUCT TRUSS



PART PLAN AND OUTLINE ELEVATION



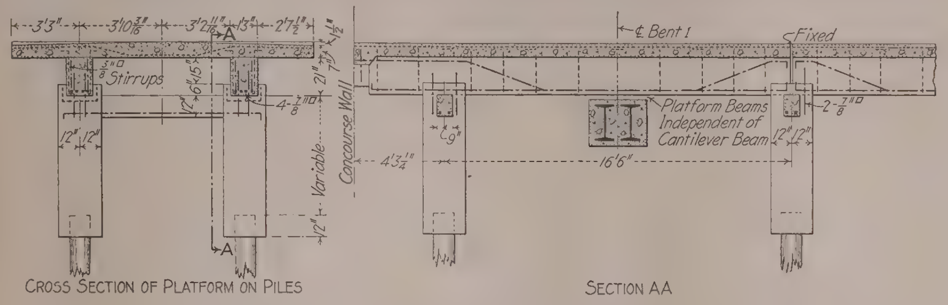
CROSS-SECTION OF TYPICAL BAY—EYE BOLTS USED IN WALL DETAIL



PLATFORM ON CINDER FILL

sign greater than for the design with columns on platforms.

The details of the longitudinal steel purlins supporting each side of the concrete-encased smoke ducts, the main rib rafters between columns, and the details of the columns are shown in the accompanying drawings. The clearance between the walls forming the smoke ducts and the form of the smoke ducts have been fixed by experiments which were made to determine the minimum clear width at top which could be used without producing back pressure from engine exhaust, or preventing the free escape of smoke, gas and cinders from locomotives. The inner curved surfaces deflect the cinders onto the roof of the train shed and prevent their return through the duct openings.


Stirrups
Concourse Wall
Variable
¢ Bent 1
Fixed
Platform Beams Independent of Cantilever Beam
16'6"
Cross Section of Platform on Piles
Section AA

SLAB AND BEAM DESIGN OF PLATFORM FOR NORTH BAY

To make the tests, a curved adjustable wooden shield was placed on each inner side of a smoke duct above the smokestack of a locomotive in the Hoboken shed, the rails greased and brakes of the tender applied, and the action of the blast observed, using different widths of opening with the adjustable shield. It was found that free escape without back compression occurred down to a clear opening of about 16 in. between the tops of the curved shields. To avoid any possibility of back compression, the clear width between curved side walls at top of ducts has been made 21 in. in this structure and at Jersey City. The clear width of 3 ft. at the bottom of the smoke duct was determined by the possible swaying of engines, the sagging of engines to one side due to weak or broken springs, and the prevention of a driving storm from reaching the platforms by a proper relative height to width between duct walls. A diagonal line extending downward toward the platform and touching the inner edges of top and bottom of opposite smoke duct walls falls outside of the platform.

In order to deflect up through the duct openings the smoke and cinders which would strike the flat bottom flanges of the main rib rafters and also to protect the metal, cast-iron deflectors have been provided, as noted. These deflectors are shaped like a letter V, with sides forming an angle of about 45 deg. and bolted to the bottom flanges of the girders.

Provisions for Future Track

On the north side, the property boundary line follows the center line of the old Hamburg sewer. As already stated, the tenth track has been temporarily omitted and the special details shown in the accompanying cross-section have been adopted to allow for future extension when required. The height of the outside columns is kept the same as the interior columns, so that they can be shifted laterally with the side-wall framing. The connection of the girders is made by special connecting angles, the ends of the girders being milled for the future splice.

In order to support the outside row of columns, which come over the sewer wall, it was necessary to use cantilever beams on pile foundations as shown in the drawing. The platforms are all reinforced-concrete slabs on cinder fill, except in the northerly part of the shed, where a beam and floor slab construction is to be carried by piers. The probability of settlement of this filled-in ground at the old Hamburg Canal site was considered sufficient to warrant this extra expense, as well as the use of piles for supporting a part of the platform piers. Examination at the site when the excavating is done will determine the extent of work for which piles will be required.

Expansion and Drainage Provisions

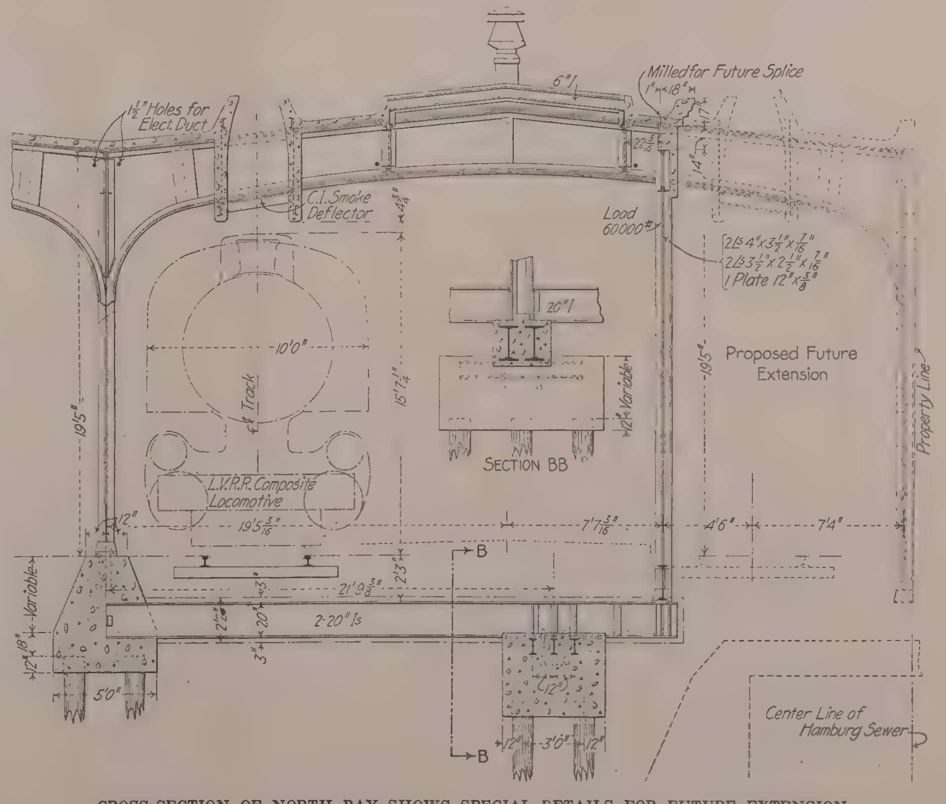
No lateral expansion joints have been provided, as it has been found in the other sheds of this type previously built that the main curved rib rafters have ample flexibility to take care of all lateral expansion. Longitudinal expansion joints are provided across the width of the structure and are spaced every fifth panel, or 165 ft., apart. Special care has been taken to insure watertight joints, as the details in the drawings clearly show.

All tracks and the column bases are on an ascending grade of 0.32 per cent toward the headhouse, and the drainage is thus easily carried away from this end and down the special cast-iron drains attached to the columns at the expansion joints. Lateral 6-in., 8-in. and 10-in. standard cast-iron drain pipes lead to the Hamburg sewer on the north. A 3 x 4 ft. conduit of reinforced concrete is carried transversely across and under the tracks near the track bumpers to provide for distribution of the several service pipe lines. The removable covers of this conduit are made of steel plates with large holes for attachment of steam, water or other connections for cars.

Roof Lights of Unusual Type

The roof lights are of unusual design, used for the first time in these train sheds. It was desired to make this part of the construction as nearly permanent as the rest of the structure if possible. It was, therefore, decided to adopt the Keppler system of roof lights having an all-glass under surface consisting essentially of a series of square glass units separated and supported by 1:2 concrete mortar ribs reinforced by steel rods.

The units used are 1¾ in. thick and 6 in. square, and the roof light panels are carried by 6-in. I-beam rafters 5½ ft. apart and bent as shown. The weight complete is 16 lb. per square foot. The top surface slopes about 1¼ in. per foot, and the bottom surface, on account of the shape of the glass units, forms an all-glass under surface of excellent appearance. An elastic light reflecting cushion of special material is provided between the glass units and the concrete ribs. The entire roof light con-



CROSS-SECTION OF NORTH BAY SHOWS SPECIAL DETAILS FOR FUTURE EXTENSION

Note the cantilever beam details for supporting columns, which cannot be carried on piers because of interference with the old Hamburg Sewer.

struction is to be insulated from the train shed supports by expansion joints filled with rubber cement or minwax and layers of asphalt paper attached by means of hot asphalt, to prevent the transmission of vibration from the substructure. Tests recently made on this 1¾-in. type of roof light showed an ultimate carrying capacity of 350 lb. per square foot on a 5 ft. span.

Ventilation is provided by means of the smoke ducts and additional ventilation at the ridge is supplied by 105 Kernchen siphonage ventilators to be furnished by the Kernchen Company, of Chicago, there being one of these ventilators located at the roof ridge line for each bay of the train shed.

As Scott Street extends along the southerly side of the train shed and other property ownerships along the north side, the 8-in. concrete side walls are to be made somewhat higher than is usual—7½ ft. above top of rail. Above this side-wall lighting is provided for by using ⅜-in. solid-rolled Pennsylvania wire glass, set in metal frames, with four sliding panels in each bay for ventilating purposes.

The side-wall lighting is to be installed by Mesker Brothers Iron Company, of St. Louis. The steel is being fabricated by the American Bridge Company. Lincoln Bush, consulting engineer, of New York City, prepared the plans and specifications and checked the bridge shop details, reporting to E. B. Ashby, chief engineer of the Lehigh Valley Railroad Company.

States Ten Difficulties of Public Service Regulation

Ten difficulties of state regulation of public utilities were named by H. O. Garman, chief engineer of the Indiana Public Service Commission at the joint meeting Feb. 4 of the Indiana Engineering Society and the Indiana Sanitary and Water Supply Association. They are as follows: Resentment on the part of the municipal governments toward state interference; change of personnel of commission after the members have been educated to their duties by experience at the expense of the public; lack of continuity of policy due to change in organization; attempts at political advertisement on the part of some city officials by starting trouble where no real trouble exists; lack of some form of civil-service restriction for the protection of the commission in obtaining its employees; lack of a co-operative spirit; political ambitions of commissioners; lack of publicity of the right sort concerning the activities of the commission; lack of confidence in the commission; lack of funds to carry on the work properly.

OLD FREIGHT CARS are no longer piled in a heap and burned on the Baltimore & Ohio Railroad. Some months ago the company began reclaiming the lumber and metal parts and utilizing the salvage. Lumber is resawed and planed until the outside defects are removed, after which it is made into smaller sizes and shipped from point to point over the road for repair work, or the erection of small buildings. A 90-ft. front platform at Keyser, W. Va., and a 300-ft. icing station 300 ft. long at Cumberland, Md., are among the structures built entirely from this reclaimed material. It is estimated that $50,000 per year can be saved by the new system.

War's Demands Cause Prices of Waterworks Chemicals to Soar

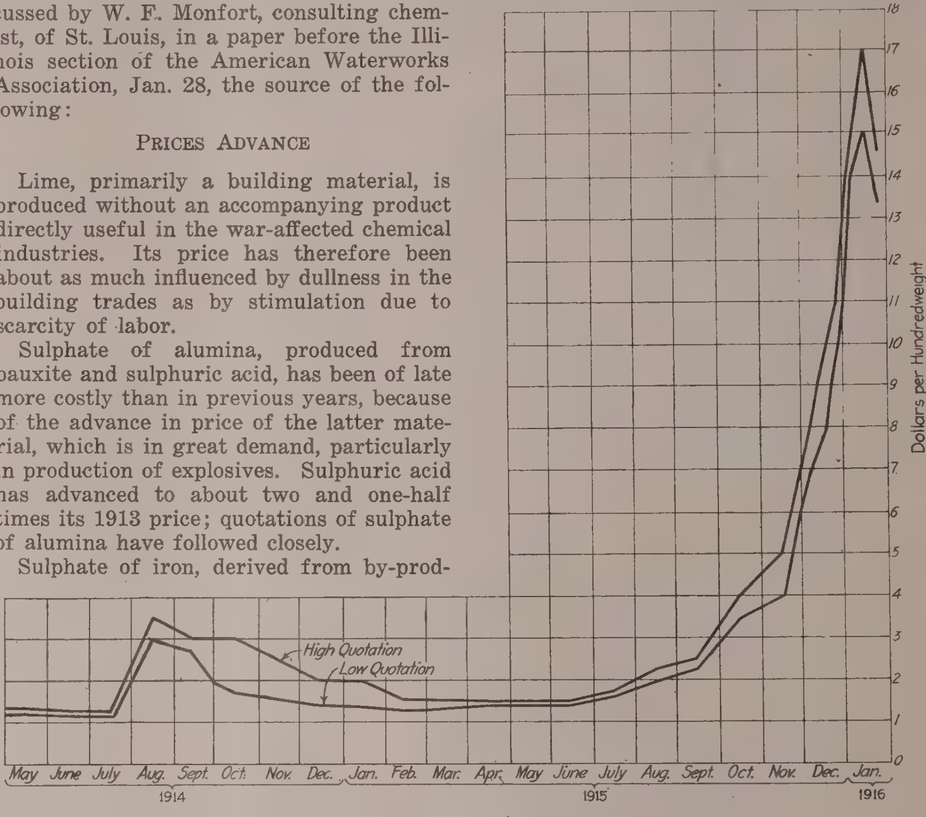
Hypochlorite Advances and Exports of Various Other Chemicals Have Reduced Supply Available for Filtration Work in United States

CHEMICALS commonly used in water purification have been affected in divers measures by the continuation of war conditions. Generally they are produced in large quantities for other purposes, while their application to water treatment is of minor importance to the manufacturer, although of first significance to the waterworks man. Some of the developments in the chemical industry which are of great significance to waterworks men were discussed by W. F. Monfort, consulting chemist, of St. Louis, in a paper before the Illinois section of the American Waterworks Association, Jan. 28, the source of the following:

PRICES ADVANCE

Lime, primarily a building material, is produced without an accompanying product directly useful in the war-affected chemical industries. Its price has therefore been about as much influenced by dullness in the building trades as by stimulation due to scarcity of labor.

Sulphate of alumina, produced from bauxite and sulphuric acid, has been of late more costly than in previous years, because of the advance in price of the latter material, which is in great demand, particularly in production of explosives. Sulphuric acid has advanced to about two and one-half times its 1913 price; quotations of sulphate of alumina have followed closely.



BLEACHING POWDER PRICE SOARS AS UNITED STATES ENTERS WORLD MARKET

Sulphate of iron, derived from by-products of wire mills, has found no large new application on account of the war, and has suffered no marked change in price.

Soda ash is firm at prices almost threefold those of a year ago.

Sulphate of copper has advanced greatly. Its primary use is as a plant disinfectant or insecticide. In Bordeaux mixture it is extensively used as a spray for fruit trees. It forms the basis for manufacture of paris green. It is further used in metal plating and in dyeing textile materials. Its application to water purification is minor. Both sulphuric acid and copper (copper ores) have been greatly affected by war industries —sulphuric acid as above cited; copper as required for ammunition. Values are speculative. Before the war the market was on a basis of 4½ to 4¾ cents a pound, and was subject to no important changes until early last month, when a 10-cent level was reached. Foreign demand has been emphasized during the last three months as a result of the prohibition by the British Government of manufacture, for the purpose of assuring a greater supply of copper for war needs, as well as in anticipation of the important spring requirements. England had controlled the foreign trade, Germany participating to a minor extent; but with these sources cut off practically full reliance was shifted upon our producers. The export trade has grown to proportions beyond all possibility of fulfillment, but no plans are reported to enlarge producing facilities based upon the present exceptional outlet. Quotations on Jan. 22 were at 22 to 23 cents a pound. Immunity from infested orchards and potato fields and algae-burdened reservoirs is to be purchased at higher cost so far as it is secured through copper sulphate and its derivatives.

HYPOCHLORITE IN DEMAND

Prices of calcium hypochlorite have likewise been seriously affected for several reasons. It is produced in this country as a by-product of caustic soda. Electrolysis of common salt (sodium chloride), either in solution or in a fused state, yields sodium (sodium hydroxide) and chlorine. Shipment of chlorine in liquid form in steel cylinders has been practised to a considerable extent in this country, but until very recently this procedure was not permissible in some countries. For safety and convenience in shipping it has long been the practice in all countries to combine chlorine, however produced, with lime. Treatment of this product with acid—even with carbonic acid—releases the full amount of chlorine from bleach. In this form it is primarily in greatest demand by manufacturers of textiles, in bleaching paper, cloth, etc. Minor uses are in some forms of chemical manufacture, disinfection and water treatment.

The latter use in America has been wide and successful, so that hypochlorite of lime has afforded a standard of cheapness and efficiency with which other sterilizing agents were compared. Its general use in water sterilization has raised the standard of purity demanded by water consumers and by sanitarians, for it was the agent which first gave practically perfect elimination of organisms of the colon group at costs which were not prohibitive.

Immediately after war was declared the market stiffened, and bleach rose in price through September, 1914, falling to normal, or nearly so, in the early part of 1915. During the past seven months the stringency has increased. The diversion of large quantities of chlorine to chemical manufacture was one potent factor; one former producer of bleach is now using all his chlorine output in manufacture of chlorinated organic products. Others have diverted at least a large part of their output, and instead of making bleach in large quantities are selling much of their chlorine in liquid form.

Last summer quite a stir was made in the daily press by reports that liquid chlorine was being shipped in large quantities to the seat of war. Statements were given out by three producers that they had not been approached by foreign representatives. However, exports of chlorine have been made from New York in later months; for example, there are reports of shipments valued at $14,526 to France, Mexico, Cuba and Argentine in December, as well as one shipment of 4000 lb. (value $1,000) to France last month. Speculation as to the uses of this exported chlorine is idle. The fact remains that not only in this country is its use in general ways greatly increased, but the world market is drawing upon the available supply of the United States and is thus limiting the production of the older secondary product (bleach), which has held its own for a long time as a convenient form for the shipment of chlorine.

DECLINE IN IMPORTATION OF BLEACH

Dates	Pounds	Valuation, Cents Per Lb.
1912—Jan. to Dec. 31	72,706,732	0.82
1913—Jan. to Oct. 31	52,115,552	0.82
1914—Jan. to Oct. 31	31,172,596	0.96
1915—Jan. to Oct. 31	7,079,076	1.26

For the purpose of comparing prices New York wholesale quotations are used. Prior to 1914 the normal price was about $1.25 per 100 lb. The production in this country was supplemented by importations from England and Germany. In August, 1914, when the German supply was cut off, prices averaged $3 to $3.50, dropping within the next four months to $1.50 or less. This condition prevailed from February to June. Since then there has been a rising tendency which has not yet passed; quotations Jan. 14 were at 15 to 17 cents per pound, and on Jan. 22 13½ to 14½ cents.

FOREIGN SHIPMENTS

For several months the domestic supply has been practically valued by second hands, and for immediate delivery or on forward orders it has been difficult to find sellers. One Western city which last year had a contract for a supply at 1⅞ cents per pound, received as the low bid for 1916 an offer of 9½ cents. An Eastern city recently had an offer at 16½ cents on the year's supply.

Importations slackened in 1914 and have fallen to practically nothing at the present time.

While importation of bleach has not entirely ceased, for shipments are still received at New York from Liverpool, our exports are largely increased. From Dec. 1, 1915, to Jan. 22, 1916, the imports reported at New York aggregate 289,445 lb.; the record of exports to Sweden, Argentine, Brazil and Chile for the first week of this period shows a total of 228,970 lb. The first week of January had a total of 666,965 lb. to France and Sweden, valued at $23,350. In the reports from week to week the weights are not always given; the values appear. The total value given for exported bleach in the seven weeks' period since Dec. 1, 1915, is $51,497.

Reports on foreign market for several weeks past are to the effect that bleaching powder is very scarce in Holland, and nominal in London, and that any business passing in Liverpool is at special terms that are not reported.

Altogether the outlook for cheap hypo during 1916 or during the high tide of chemical production is discouraging. In considering offerings it must be borne in mind that only the chlorine content is of value; that the lime shipped and applied in connection with this chlorine adds no increment of value. If bleach containing 25 per cent of chlorine is purchased at 7 cents per pound, this is equivalent to 28 cents a pound available chlorine; 35 per cent bleach at 9½ cents corresponds to 27.17 cents per pound of available chlorine.

The market résumé for the week ending Jan. 22 is as follows: The general quotation for spot bleach is 14 to 15 cents per pound. Demand has assumed more quiet proportions and occasional sales have been made as low as 13½ cents per pound. Contract shipments are reported heavy, and it is believed that no great amount of stock is offered for immediate shipment.

The condition may be summed up as follows: Imports have practically ceased. Exports are still increasing. Production has been greatly diminished on account of diversion of chlorine to extraordinary uses and the increased demand in chemical manufacture. The output of the limited number of factories in the United States where cheap electric power is available has become utterly inadequate for the world market in which we as minor users of bleach are now buying. There is great difficulty in securing a dependable supply, even at prohibitive cost, of this standard material which has stood between many a small community and an unsafe water supply.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

What Is an Engineer?

SIR: Permit me to express my interest in the subject recently mentioned in your bright pages, under the caption "What Is an Engineer?" The questions, or rather set of questions, I understand was given to a great number of engineers, widely spread and of all complexions. And the typical engineer slowly evolved through the strata of innumerable replies is, without doubt, the man we hail to-day as master of the big job. But there seems to be dissatisfaction with "Frankenstein" as he stands before us. The extremely low percentage allowed for technical qualifications, as compared with that for a kind of equipment that would be equally essential in runnining a first-class grocery business, is not the working equation that has heretofore obtained with those preparing for the profession.

I believe, however, that a straw man, a Frankenstein, indeed, has been erected from the accumulated data, through failure on the part of some persons to co-ordinate the figures of expression. For instance, consider mathematics, and in a psychological sense, the mental faculty which intuitively knows that twice two is four, and moreover feels that the right angle is the main prop of geometrical form and can think in its terms; which also knows how once was found the resultant of two unequal, unlike parallel forces, and can find it again because it is bred in the bone—and now, therefore, has initiative and resourcefulness, which are but structures and superstructures on a foundation laid deep and wide upon a rock bottom; and so on through all the broad domain of technical knowledge; then we have the well-rounded, finely equipped man, the engineer supreme.

The whole matter passes through my mind in dissolving views in which I see engineers, and so-called engineers, of my acquaintance of years. The thing that has thrown a haze over the whole situation and has caused a great deal of misconception is that disease called "push." If it were the right kind of push—the momentum of a moving body, slowly and surely coming to the front, no complaint could be made. But it is another kind, a masquerade. I need say no more. Howbeit, a better day is dawning, and of this I am convinced. In that day true worth will be measured upon a scale of all-round fitness, where integrity, initiative, resourcefulness and many other admirable attributes will be only the outgrowth of a well-trained and technical mind.

P. G. MELBOURNE.

Hyattsville, Md.

Elimination of Wet Spots in Railroad Cuts

SIR: Referring to the discussion between E. L. Sinclair and J. T. Bowser in your journal concerning the methods of eliminating wet spots in railroad cuts (see the Engineering Record of Oct. 23, 1915, page 506, and that of Jan. 15, 1916, page 72), it seems to me that they are both taking more trouble than necessary to overcome the difficulty. The water in railway cuts usually comes from the banks on each side of the track, and the logical place to deal with it is in the side ditches before it gets to the track. If the soil is impervious the water will run off through the side ditches if they are properly graded and kept clear. If the ground is not impervious, then the water will soak down below the ditch and be collected in a drain pipe underneath.

In order to remove what little water gets to the roadbed itself side drains can be run from the ballast to the main drain under the ditch. These should not be separated from the ballast, as the gentlemen suggest, but should connect directly with it so there will be no difficulty about a through connection from the ballast to the main drain. Ground which is properly and adequately drained in this way will soon become hard enough so that the ballast and the subsoil will not churn up together.

There is a possibility that while the drains are ridding the soil of the excess water and trains are running, if the ground is very soft, the drain tile will become so displaced as to fill with mud and cease to operate. The cure for this, however, is not to go to a lot of expense for sheet piling and concrete walls, but simply to use No. 2 bell-and-spigot sewer pipe, placing the lengths together in the usual way, but without any jointing material in the bells. This gives ample opportunity for the water to get into the pipe, once it has reached it; and the bells prevent the pipe from getting out of line and filling with mud.

It seems to me that with the other types of construction suggested there might be many places where the continuous impervious walls would have a tendency to retain water under the track rather than to keep it out, and would make matters worse instead of better. At all events the No. 2 sewer pipe has come to be a standard means of draining wet cuts by some very extensive railway systems.

Benjamin Brooks.
Kansas City, Mo.

Why Is Registration in Civil Engineering Decreasing?

Sir: In the article on the decrease in registration of civil engineering students, published in your issue of Dec. 18, 1915, page 766, the figures given for the Massachusetts Institute of Technology are too low, evidently because plotted from the data in the annual report of the president. These figures refer to the number of students on the first of November of each year. At that period of the year the freshmen have not elected their various courses, so that they are not included. The freshmen do not elect the different courses until the second half of the year, so that it is not practicable to give accurate statistics for the current year. The numbers of students pursuing the course in civil engineering in each of the five years preceding this, beginning with the year 1910-11, were as follows: 267, 276, 264, 263 and 251. You will see from this that the number has been practically stationary within the period.

The falling off in the last year is more apparent than real, because in that year we instituted a new course called "Engineering Administration." In the year 1914-15 eleven students took the civil-engineering option of this course. This civil-engineering option is very closely allied to the older and more regular course of civil engineering, and doubtless these eleven students should be added to the 251, making the total 262 for the year 1914-15.

Within the same period the enrollment of freshmen in civil engineering was as follows: 56, 70, 60, 54 and 60. The enrollment of all engineering students in the latter half of each of the years (the latter half, as I have explained, being the period when the elections have been made) was 1216, 1232, 1260, 1336 and 1386.

Although the number of students in civil engineering has remained practically stationary, there has been a decline in the proportion of engineering students pursuing this particular course. Such a decline might be expected in view of the greater variety of opportunities that are now presented.

Richard C. Maclaurin,
President, Massachusetts Institute of Technology.
Boston.

The Economic Side of Sand Testing

Sir: I was interested in reading H. H. Scofield's criticism in the Engineering Record of Feb. 5, page 188, of Chapman and Johnson's article on the economic side of sand testing, and to note the application there made of Fuller's ideal curve.

As a matter of fact all these gentlemen are in error in attempting to apply Fuller's ideal curve for concrete to any mixture of cement and sand alone. This curve (see the *Transactions* of the American Society of Civil Engineers, Vol. 59, page 67) was only put forward as a suggestion toward the obtaining of greater strength and density in concrete; that is, toward the better proportioning of the cement, fine aggregate and coarse aggregate. No experiments were made on, nor was the curve intended for use with, mixtures of cement and sand alone.

I have lately, however, been carrying on a series of experiments toward developing a curve to fit maximum densities of mortar, and have reached the conclusion that the same general form of ideal curve is applicable as to concrete with the exception of a change of constants for the values of a and b, depending on the proportion of cement in the mortar, the constant increasing materially as the percentage of cement increases.

My experiments indicate that for a sand having maximum grains of 0.25 in. diameter, and a mortar of 31 per cent cement as used in Professor Scofield's experiments, the value of a in the ideal curve should be 0.0379, and of b 32.2, which is, as nearly as I can judge from the small-scale diagram, about the value which Professor Scofield adopted.

It has thus accidentally happened that the coefficients adopted applied to the mixture used, but I wished to call attention to this fact so that the ideal curve for concrete will not be assumed to apply at all times to mortars without a careful selection of constants.

I cannot resist calling attention most forcibly to the great improvement of strength by grading sands to approximate an ideal curve, as shown by these tests of Professor Scofield. Assuming that mortar from the quoted sand "B" gave perfectly acceptable strength in the completed work, the relation of strengths shown make it possible to have cut out 25 per cent of the cement in use with the blended sands and still obtain the same strength as would have been obtained with the sand "B."

Assuming the case cited by Messrs. Chapman and Johnson, the amount of cement thus saved would approximate 23,600 bbl., which, at say $1.50 per barrel for cement in a Western state, would amount to $35,400, a total saving on the cement and sand of $57,680, or nearly $1 per cubic yard of concrete.

Where large masses of concrete are to be used, as in masonry dams, attention to grading not only produces stronger and more watertight concrete, but also pays a handsome interest on the investment of the trifling extra labor involved.

W. B. Fuller,
Consulting Civil Engineer.
New York City.

Writing Land Descriptions

Sir: Lawmakers have devoted much time to regulating the practice of engineers, architects and surveyors, but no attention seems to have been given to the important function of writing descriptions for the transfer of real property. A surveyor may possess enough licenses to paper his office walls, and be a paragon of perfection in his line of work, but as long as he has to deal with faulty descriptions, just that long will his condition be retarded in its upward trend toward the ideal.

In this state any one may write a description, take it to the county recorder and have it put on record in the form of a deed; thus it stands, whether right or wrong, as the grantee's protection against encroachment. This laxity has resulted in many cloudy titles, useless litigation and much hard unappreciated work for the surveyor. In many transfers there can be no doubt that the intention was honest, but the ability to state clearly what was intended was entirely lacking. On the other hand, the intent to defraud is quite evident in some cases, the opportunity to do so being made possible by the ability to draw a deed with an ambiguous description.

R. W. Cautley in his "Descriptions of Land" says in Section 1: "Since the ownership of land is the most universal and, at the same time, the most permanent form of property, it follows that conveyancing of land constitutes the most common and important class of transactions in the everyday business of the world."

In view of the importance of this class of work, it seems to me that appropriate restrictions placed upon indiscriminate description writing would correct this evil. If, for instance, before a deed be accepted for record the description be examined by a licensed surveyor or other person qualified to test its accuracy, and if found to be incorrect, rejected, future records will be better than those of to-day. If the courses given were obtained astronomically—not from needle courses with the variation set off—the same line would not be given two or more bearings, as is quite often the case with division lines where adjoining property has been described separately. If the description be based on actual survey, the survey executed by a responsible party, and well monumented, the uncertainty of identifying the property described would be eliminated.

To be able to write descriptions one should have some knowledge of plane trigonometry, be familiar with the kinds of trees and objects used for ties, be able to state in a clear, concise manner the meanings intended, and have a fair knowledge of the law of conveyancing. I should like to see the above qualifications in our law books.

L. L. Mills,
Licensed Surveyor.
Santa Rosa, Cal.

HINTS FOR THE CONTRACTOR

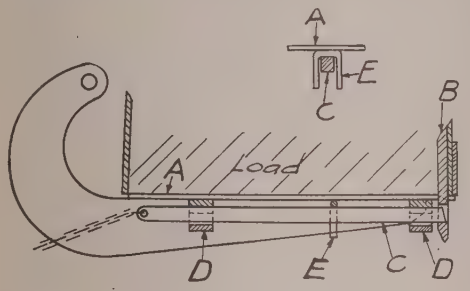
Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Roller Makes Dipper-Latch on Steam Shovel Work Easily

A BENT piece of round iron placed between the latch bar and the door of a steam shovel dipper makes it easy to draw the latch and stops it from sticking, according to F. A. Crabb, of Vandalia, N. Y. The device, which was described in the January number of the *Excavating Engineer*, is illustrated by the accompanying sketch, in which A represents the dipper door, B the latch bar keeper, C the latch bar, D the guides, or brackets, and E the roller. It will be seen from the sketch that the weight of the load on the dipper door bears upon the underside of the latch keeper, upon the upper side of the outside bracket and the upper side of the inside bracket. A very simple and inexpensive way to prevent the latch bar from sticking is to take a piece of round iron either ¾ in. or ⅞ in. in diameter, whichever fits best, bend it to a three-sided piece as shown by *E* on the top sketch, and slip this in between the latch bar guides as shown in the lower sketch. It will be seen that this piece of round iron acts as a roller. Mr. Crabb says that it makes the dipper dump much more easily.



ROLLER REDUCES FRICTION ON DIPPER LATCH

Types of Dredging Equipment Best Adapted to Land Drainage

POWER MACHINERY is now available which will construct outlet drainage ditches of all sizes, and under all conditions of soil and water, more cheaply than can be accomplished by any other method, according to D. L. Yarnell, drainage engineer of the Office of Public Roads and Rural Engineering. In a special bulletin issued recently by the Department of Agriculture, the uses and limitations of the different machines that have been employed in such work are summarized by Mr. Yarnell, whose conclusions follow.

The floating dipper dredge is more widely used in drainage work than is any other type of excavating machine. For work through wet land no other excavator will equal it in cheapness of construction of ditches having a cross-section of from 100 sq. ft. to 1200 sq. ft. It is by far the most efficient machine to use where many stumps will be encountered. Owing to its limited reach it is not generally applicable to levee construction. Dipper dredges as constructed for drainage work range in capacity from ½ cu. yd. to 4 or 5 cu. yd. The sizes most commonly used vary from 1 to 2 cu. yd. The smallest dredge costs about $5,000; the cost increases rapidly with the capacity of the dipper. The floating dipper dredge should be operated downstream, where practicable, to insure sufficient water at all times.

In general, the clamshell or orange-peel dredge is not well adapted to ditch construction, especially if there be stumps to handle. Certain types of soil, such as the muck of southern Louisiana, can, however, be handled to advantage with this machine. It is also suited to levee building when a long boom is used.

The dragline scraper excavator is constantly increasing in favor for drainage work. It is especially suited to the construction of ditches and levees of large cross-section, where the ground is sufficiently stable to support the machine. The scraper excavator is also suitable for ditch cleaning.

The various forms of so-called dry-land machines find quite extensive use in drainage. The dipper and orange-peel dredges of the dry-land type are suitable for use where sufficient water cannot be had to float a dredge. The templet and the wheel types of excavators are applicable to open land, where the soil is neither too hard nor too wet. The ditches cut by these latter machines are superior in hydraulic efficiency to those of similar section cut by any other type of excavator. The dry-land machines should be operated upstream.

The hydraulic dredge is not suited to ordinary drainage ditch construction. It has been used to some extent in cleaning ditches, and, with the use of slope boards, has in at least one instance made a satisfactory record in levee construction.

Wheeled Mixing Plant and Travelers Build Sewer Rapidly

By E. NOVAK
Cincinnati, Ohio

FOUR traveler derricks and a concrete plant on wheels, all spanning the sewer trench and running on the same track, were used recently to complete a large concrete sewer in Cincinnati at a rapid rate. The sewer, which will intercept the sanitary flow previously carried by Mill Creek, is 6600 ft. long and has an egg-shaped section 6 x 6 ft. except for a distance of 200 ft. where it crosses the creek, and where a twin section is employed. The bottom of the sewer trench was 10 ft. or more below the creek and only 10 to 50 ft. from it, and in addition the work was but 250 ft. from and nearly 50 ft. below the Miami and Erie Canal. For this reason special care was taken to have the wood sheeting tight. It was driven in two sets, and averaged 18 ft. in depth. For the same reason plenty of clearance was provided for by making the top set 12 ft. wide and the bottom set 10 ft. wide, giving 18 in. on each side of the sewer.

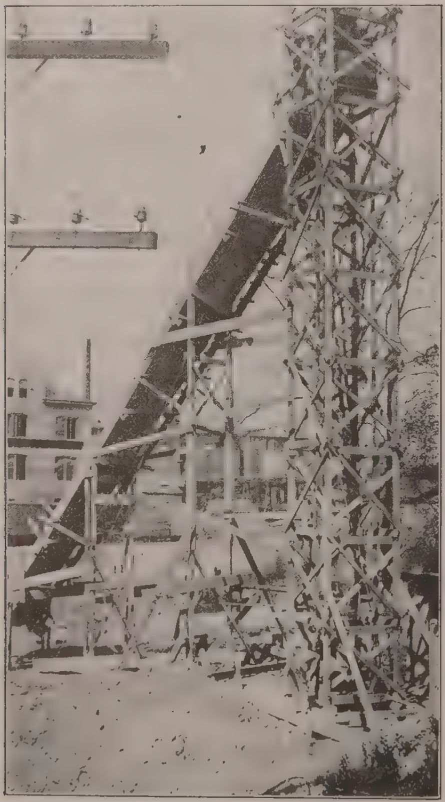
On account of the proximity of the work to the creek some trouble was experienced with keeping the trench dry, and the work was flooded no less than five times. In spite of this, however, no damage was done and no serious accidents occurred. Three small centrifugal pumps and two pulsometers were used.

The plant was arranged so that each unit had to do a certain amount of work each day. Nevertheless the units were spaced so that any accident to one would not result in holding up the rest. One traveler derrick with a 1-yd. clamshell bucket on a 50-ft. boom, facing the direction in which the work was progressing, took out the first 10 ft. of excavation as the upper set of sheeting, with two sets of braces and rangers, was placed. Back to back with this traveler was a second which took out about 5 ft. more, while the lower set of sheeting

TRAVELING DERRICKS AND MIXER COMPLETED SEWER AT RATE OF 60 FEET A DAY was being placed. Following this was a third derrick facing the same way as the second, which finished the excavation and left the trench ready for the concrete work. Behind this came the mixer, which discharged through a hopper in the platform on which it was mounted into chutes leading to the forms. Owing to the irregularity of the water supply, the mixer carried its own water in barrels mounted on the platform. Two days were required between pouring the invert and the arch, and the mixer was pulled back and forth by a line to a winch head of the nearest derrick. The work was drained to a pump and a portable boiler stationed behind the mixer. The sumps for this pump were spaced about 300 ft. apart and water was carried to them from the excavation ahead by an 8-in. underdrain. The fourth traveler followed the concrete mixer, removing the bracing and backfilling the trench.

As the arch forms had to be left in place three days after pouring concrete, 240 lin. ft. of them were supplied. Steel forms of Blaw design were used. They were without interior bracing and ran on a track laid on the completed invert. The concreting was the limiting factor in the speed of the work. It was found advantageous to pour 120 ft. of invert one day and 120 ft. of arch the next, always keeping one completed invert section between the new arch and the advance section of invert. While this made it necessary to keep open a large amount of trench it allowed rapid construction at a reasonable cost. The maximum amount of sewer completed in any one week was 420 ft., but the open trench part of the work was carried on at a rate which nearly averaged 60 ft. for every full working day.

The railroad siding at which materials for the job were delivered was on the other side of the creek from the work. A 2-ft.-gage track was built from this siding, carried across the creek on an I-beam bridge supported by small concrete piers, and extended to and along the line of the trench for delivering materials to the concrete mixer. A locomotive was used to haul the small cars. Material cars were unloaded at the siding onto a platform over the narrow-gage track, from which the small cars were charged by gravity. In both the sand and gravel piles was built a brick furnace fired with coke, from which large pipes radiated. The sand and gravel were heated without trouble in this way, so that the work was never held up by cold weather. A portable telephone line was carried along the work, keeping it in touch at all times with the yard and the office.



TOWER DID WORK OF DERRICK IN DISPOSING OF TUNNEL EXCAVATION

TRAVELERS AND MIXER SPANNED TRENCH—NARROW GAGE TRACK AT RIGHT

A short tunnel 120 ft. in length was built at one point under the track of the Baltimore & Ohio Railroad. The excavation from this tunnel was disposed of by hoisting it in a tower and dumping it down a wooden chute from the head of the tower to the creek. The skip in the tower dropped below the floor of the excavation and was operated by a 10-hp. electric motor. The tower was built in place out of second-hand lumber, required only a laborer to run it, and did the work of a derrick and hoisting engineer.

The work was done by the Thurber & Browning Company for the city of Cincinnati, of which Frank S. Krug is city engineer and Walter E. Sullivan sewer engineer. C. L. Harrison was engineer in charge of the work for the city. The plant layout was designed by H. Thurber, of the contracting firm, who gave the work his personal attention. N. E. Morrow was in charge of the work as superintendent for the contractor.

Working Air Out of Pipe Line Tested in Long Sections

By R. C. HARDMAN
Colorado Springs, Col.

BY USING a hand force pump to raise the test pressure to the required 250 lb. where necessary, loosening the high joints to permit the escape of air, and providing heavy end bracing and clamps to take the thrust of ½-mile sections under test pressure, an 8-in. steel pipe line about 8½ miles long was quite recently tested satisfactorily.

The specifications provided for testing the line to a pressure of 250 lb. per square inch before backfilling the trench. Part of the line received normally more than this pressure when the discharge end of the line was closed, but, as no valve was provided at the reservoir, static pressure could not be obtained in operation. Where the pressure exceeded the required amount the pipe was simply capped and the line examined. Where the pressure was less than 250 lb. it was raised to that figure.

The tests were made about every half mile immediately upon the completion of that amount of pipe-laying. A small hand-operated boiler testing pump was used for the purpose, although some doubt was had as to whether it would be feasible for increasing the pressure in such a long length of line—about 2½ miles being the longest section tested. In preparing for the test a cast-iron cap fitted to the end of the pipe and tapped to receive the discharge of the test pump was securely fastened to the last section of pipe. This was accomplished by means of a steel bar over the casting, through which bolts were passed, the bolts in turn being fastened at their opposite ends to a steel clamp which bolted around the pipe. Water-tightness was secured by means of a rubber gasket between casting and pipe end. As the pressure tending to force the casting off the pipe and to disjoint the line was about 12,500 lb., a system of timber bracing was employed. At the first test, which was at a creek crossing, the pipe was braced against the opposite bank so effectively that the line was buckled completely out of the trench, the last joint being broken.

As the line followed the contour of the ground there were many high points in which air collected. The procedure in making the tests was to cap and brace the lower end, loosen all high joints to allow escape of all air and close the valve in line at the intake. Water was then hauled in barrels for the operation of the pump. The time consumed in reaching the desired pressure was not uniform throughout the series, varying from two to six or seven hours for four laborers working in ½-hr. shifts of two men each. The variation in time was due to the amount of additional pressure necessary and to the care with which the accumulated air had been released. At times when it was thought that the air had been carefully attended to no headway would be made by the pump, a more careful inspection always revealing the fact that some air still remained in the line. In fact, to increase pressure in this way it is absolutely essential that all air be removed.

PUBLIC-UTILITY-COMMISSION COSTS IN INDIANA were given as 1½ per cent of the cost of reproduction new by H. O. Garman, chief engineer of the Indiana commission, before the joint meeting, Feb. 4, of the Indiana Engineering Society and the Indiana Sanitary and Water Supply Association. They were made up as follows: The combined cost of the appraisals, audits and hearings amounts approximately to 1 per cent by the utility, ¼ per cent expended by the commission and charged against the utility, and ¼ per cent expended by the city. Since May, 1913, the commission staff has evaluated fifty-one public utilities having a total physical value of approximately $33,300,000.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Court of Appeals Upholds Thacher Patent in Baltimore Case

Deciding for the Thacher concrete bridge patent, in the appeal from the decision in its favor made by the Maryland District Court on Feb. 25, 1915, the U. S. Circuit Court of Appeals for the fourth circuit on Feb. 2 affirmed the decree of the lower court "on the reasoning in the opinion of that court." The original suit was brought by Edwin Thacher against the City of Baltimore for infringement of his patent in the construction of the Fallsway viaduct.

The original decree, which is affirmed by Judges Pritchard, Knapp and Woods of the Court of Appeals, stated that claims one and three of Thacher's patent 617,615, granted Jan. 10, 1899, for reinforced-concrete arch construction, are valid and original, that the defendant, the Mayor and City Council of Baltimore, violated and infringed the rights of the plaintiff in the Fallsway viaduct, that an injunction issue perpetually restraining the defendant from further infringement, and that the plaintiff is entitled to $5,000 damages, with costs.

The opinion of Judge Rose, upon which the decree is based, upholds the priority of the fundamental claim in Thacher's patent for an improved concrete arch structure in which iron or steel bars are imbedded in the concrete near the outer and inner surfaces in pairs, each independent of the other and one or both extending well into the abutments. Evidence of royalties already paid for licenses to build according to the patent was cited. Some previous patents, such as the Monier and the Von Emperger, were discussed, and held not to show priority in the details of the Thacher patent.

Discuss Proposed American Society Move at Regular Meeting

No opposition whatever was voiced to the proposed move of the American Society of Civil Engineers to the Engineering Societies' Building, when the matter was put up for discussion at the regular meeting of the society in New York Feb. 16. The four men who spoke—Clemens Herschel, chairman of the committee that handled the negotiations for the society; Dr. Alexander C. Humphreys, of the United Engineering Society, as well as a member of the American Society of Civil Engineers; Dr. E. L. Corthell, president of the civil engineering body, and Henry G. Stott, past president of the American Institute of Electrical Engineers, and a former director of the American Society of Civil Engineers—were all emphatically in favor of the proposed move. Their keynote seemed to be solidarity of the whole engineering profession in public questions.

Materials Standards to Be Published in Foreign Languages

The executive committee of the American Society for Testing Materials has made arrangements with the Department of Commerce by which the standards of the society, insofar as they affect the requirements of export trade, will be translated into foreign languages. The department will bear the expense and the translated standards will be distributed among the U. S. Consular Offices and made available at moderate prices to American manufacturers interested in foreign trade. It is planned that each specification in a foreign language will be accompanied by the original English version and that all numerical quantities will be both British and metric.

Sixteen Hundred Engineers Hear First Military Lecture Under Army Supervision

Captains Robins and Coiner Explain Organization and Duties of Engineers in War and Opportunities for Technical Men in National Defense

LIMITED in numbers only by the capacity of the main auditorium of the Engineering Societies Building and a second hall, pressed into service for an overflow meeting, 1600 engineers of New York City listened on Monday evening to the first of the series of seven lectures on military engineering and national defense, organized under General Leonard Wood's direction by the national societies of civil, mechanical, mining and electrical engineers. While Captains Thomas M. Robins and Richard T. Coiner, Corps of Engineers, U. S. A., were explaining to two enthusiastic audiences the organization and duties of engineers in war, and what engineers in civil life will be called upon to do in the defense of the United States, the representatives of the New York Fire Department, following orders regarding dangerous over-crowding of buildings, stood guard at the doorways and turned away hundreds of technical men who sought entrance to the packed lecture halls.

"This wonderful spontaneous response," said J. Waldo Smith, chairman of the meeting, "has far exceeded our wildest dreams. Where this interest will lead we cannot tell. But, speaking as chairman of the committee, if it leads or tends to bring about some compulsory requirement, whereby every able-bodied young man is required to put in at least one continuous year of hard military service under the direction of the United States Army, we feel it will be a great thing for the country, and it will be a far greater thing for the young men."

Engineers Must Be Soldiers

In beginning his address, Captain Robins emphasized the fact that warfare, as it is conducted to-day, is making greater demands upon engineering skill than ever before. But engineering work, he said, is only one of the manifold duties of engineer troops. They must be soldiers, first of all, and must know how to fight. Upon a foundation of military knowledge must be built up the training in the services of reconnaissance, demolitions, fortifications, sieges, battlefield illumination, communication, lay-out of camp, sewerage and water supply systems, general construction work and special services of an engineering nature which are beyond the technical training of combatant troops, or which require tools, implements and material, which are not issued to the combatant forces.

The engineer's work in war is not all at the front. Of course, the pioneer and ponton battalions operate in the fighting zone, but other engineer forces must be assigned to lines of communication, to the preparation of defensive lines, to sea coast fortification and in the interior of the country at manufacturing and munition works.

In European armies that are fighting to-day, Captain Robins pointed out, it is considered that about 6 per cent should be the ratio of engineers to infantry. If it is assumed that this country needs 500,000 men in the first line troops, there will be needed for their support about 1200 engineer officers and 36,000 engineering enlisted men.

Speedy Work Necessary

In military engineering time is the all-important factor. Labor is plentiful and costs nothing. "For material to work with," Captain Robins said, "you have everything that you do not want, and nothing that you do want. But you have this one great advantage—you can take whatever you want, wherever you find it, and use it, no matter what shape it is in. You do not have to worry about paying damages. If you need timber and a house is

Government to Make Soil Pressure Tests at Arlington

Experiments on the distribution of pressures through soils are to be conducted at the government's Arlington farm, near Washington, by the U. S. Office of Public Roads and Rural Engineering. A specially designed apparatus will be installed which will permit of earth pressure measurements being taken in a large number of positions during a single application of the load. This feature is regarded as an important one, and it is hoped that an unnatural rearrangement of the soil from previous load applications in various positions will be thus avoided. Earth fills up to 10 ft. thick may be accommodated by this apparatus, and it will have lateral dimensions sufficiently large to permit of obtaining the full distribution of the load in all directions.

Bone Sues City of Cincinnati

Ewald & Shadman, attorneys, in behalf of Frank A. Bone, have lodged a claim against the City of Cincinnati for the usual royalties of 10 per cent of cost for alleged violation of the Bone patent in the construction of the retaining walls in its grade crossing work. The claim refers to sums previously collected from the Chicago, Burlington & Quincy Railroad, the City of Binghamton, and others, and addresses a number of queries to the grade-crossing commission. An article and editorial discussion on the recent decision against the Bone patent will be found in this issue of the Engineering Record.

May Submit $50,000,000 Highway Bond Issue in Pennsylvania in 1917

In a recent address before the Harrisburg Chamber of Commerce, State Highway Commissioner Cunningham announced that a $50,000,000 bond issue for highway improvement will likely be submitted to the voters of Pennsylvania in 1917. The highway commissioner declared that the greatest need in Pennsylvania is a definite system whereby stretches of good roads can be made continuous from one end of the state to the other.

Ohio Will Need Highway Inspectors

A large number of highway inspectors will be needed in Ohio for road work during the coming season. With a view to obtaining men to fill the vacancies the State Civil Service Commission, Columbus, will hold examinations within the next week or two.

nearby you tear down the house and use it."

Captain Robins laid particular stress upon the necessity of supplementing engineering knowledge with actual military service. "The only way to get military training is by actual service," he said, "combined with study and reading on the subject. You can study and read and profit by it, to a certain extent, but you cannot expect to qualify for service, unless you have been in camp, or performed actual field duty. You men ought to know that most of the work, at first, will have to be straight military training, as it is taught in the Army. Every man must learn by actual experience the duties of a soldier. Then we can concentrate on the engineering phases of the work, and round out the course of instruction in its technical features."

An idea of the many things an engineer is called upon to do in service was portrayed by a series of lantern slides, showing various stages of a practice march undertaken by a force of Regulars. The bulk of the work consisted in spanning rivers with ponton bridges, opening up roads, laying out camps and preparing defensive works such as trenches, and barbed wire entanglements. Motor trucks were used effectively in transporting the bridge building equipment. Most of the ponton structures which were shown were completed a couple of hours after work on them had been begun. Another feature of the practice march was the demolition of a steel bridge with dummy cartridges.

Field for Older Men

All of the engineer's work, however, is not with the advance troops. Important service is rendered on lines of communication, such as railways, and roads. The line of communication, Captain Robins pointed out, is a field open to the older men of the profession, whose physical strength is not equal to the strenuous duties at the front, and who have not time to receive intensive military training by going to summer camps or joining organizations like the National Guard. The senior members of the profession also could be used to good advantage on the defensive lines, at munitions plants, and in the coast artillery service. These duties, together with the making of military maps and the laying out of trenches, will require a large force of engineers. This service, in the rear of the combatant troops, will not be strenuous work, but will require a good knowledge of field fortification in all its branches, not only the construction of trenches, but the preparation of the foreground, the clearing away of trees, the construction of entanglements, the placing of searchlights, and field ordnance emplacements.

"If the troops in the field are not backed up by all the resources of the country," said Captain Robins, "they will not get far, and there is nobody that will have any more to do with the development and utilization of their resources than the engineers. There will be many manufacturing plants making munitions and other supplies; thousands of engineers may be called into service to look after these plants, and to inspect materials. If the time ever comes there will be plenty for every member of the engineering profession, old or young, to do. It is only organized and united effort that will count."

Ohio Act Relating to Continuous Service Held Unconstitutional

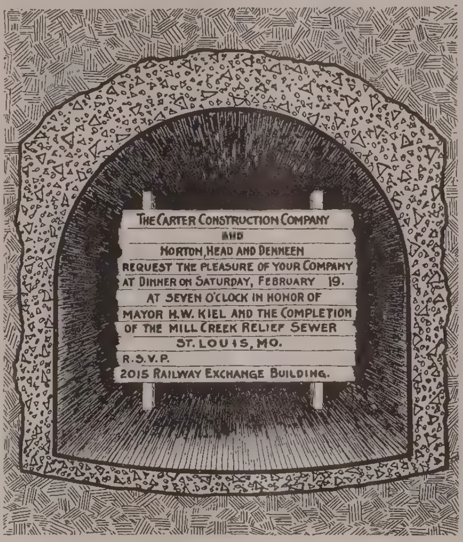
In the case of Henry M. Redd, who claimed the office of city engineer of Chillicothe, Ohio, under the clause of the state civil service act that reads "that all persons who have served the state or any political subdivision thereof continuously and satisfactorily for a period of not less than seven years . . . . shall be deemed appointees, within the provisions of this act." Judge J. W. Goldsberry, of the Court of Common Pleas, sitting at Chillicothe, held that the act was unconstitutional.

Mr. Redd had been acting city engineer of Chillicothe for twenty-one years. At the beginning of the present year the mayor appointed Morgan W. Shuitt to the office. Mr. Redd appealed to the court for aid, holding that he was entitled to the office of city engineer by reason of the clause of the civil service act, as quoted above.

Hold Dinner in Mill Creek Sewer to Commemorate Completion

The Carter Construction Company and Norton, Head & Denneen will be the hosts at a dinner to be held this evening in St. Louis, in honor of Mayor Kiel, of that city, and the completion of the 38-mile Mill Creek relief sewer, which drains 5030 acres of land. The notice to begin work was given Oct. 23, 1914, 24 months being allowed for completion. The actual time taken was 16 months.

The dinner will be prepared and served 100 ft. underground at Montrose Avenue and Rutger Street, and will be the chief feature of novel ceremonies that have been arranged for the celebration of the completion of the new sewer. The sewer will be formally turned over to that city by R. T. Norton, chief engineer for the Carter Construction Company, the general contractors, at the banquet, and will be accepted on behalf of the city by Mayor Kiel. A part of the section of the sewer, walled in for the banqut, will be outfitted as a kitchen and the dinner will be prepared there.


THE CARTER CONSTRUCTION COMPANY
AND
NORTON, HEAD AND DENNEEN
REQUEST THE PLEASURE OF YOUR COMPANY
AT DINNER ON SATURDAY, FEBRUARY 19.
AT SEVEN O'CLOCK IN HONOR OF
MAYOR H.W. KIEL AND THE COMPLETION
OF THE MILL CREEK RELIEF SEWER
ST. LOUIS, MO.
R.S.V.P.
2015 RAILWAY EXCHANGE BUILDING.

INVITATION TO DINNER IN COMPLETED SEWER

Preparedness Discussed at Boston Engineering Banquet

The part to be played by the engineer in national defence was the principal theme of discussion at the seventh annual banquet of the engineering profession, held at the Boston City Club, Feb. 8. Charles L. Edgar, president of the Boston Edison Company, was toastmaster, and nearly 500 engineers were present, including delegations from Providence, R. I., and Worcester and Lynn, Mass. Governor McCall, of Massachusetts, pointed out the opportunity for expanding engineering along social and economic lines, with particular reference to reducing waste in government. He touched upon the overlapping of functions among the 107 different departments and commissions of the state and said that there is a wide field for engineers in increasing the efficiency of governmental administration.

Col. W. E. Craighill, Corps of Engineers, U. S. A., spoke of the advantages of the proposed reserve corps of engineers in national defence. He stated that the general staff has prepared plans for the defence of Boston in case of hostilities, and that would require 100 miles of outer and 80 miles of inner trenches, to be built within ten days, which would require 25,000 men, and the expenditure of $2,000,000. William Barclay Parsons, chairman of the joint engineering societies committee on preparedness, described the plans leading toward the formation of the national engineer reserve, and John R. Freeman, of the government commission on the recent slides in the Panama Canal, commended universal military training, and urged at least one year of it for every young man in the country as a part of his education. Mr. Freeman stated that navigation through the Panama Canal will soon be resumed, and apprehended no further trouble from slides. Other speakers were Calvin W. Rice, secretary American Society of Mechanical Engineers, and Dr. John A. Brashear, Pittsburgh.

Military Lectures Enlarged to Meet Applications for Enrollment

So many engineers have enrolled for the military lecture course, organized under Gen. Leonard Wood's direction by the four national engineering societies, that it has been found impossible to care for them all in the auditorium of the Engineering Societies Building in New York, as originally planned. The committee accordingly has completed plans for three lecture courses, all covering the same ground and to be given by the same speakers as originally announced, Captains Thomas M. Robins, Richard T. Coiner and Edward D. Ardery of the Corps of Engineers, U. S. A. The following schedule will take effect immediately:

Course 1—Every Monday, 8 p. m., to March 27 in the Engineering Societies Building; orange tickets (blue tickets for stage).

Course 2—Every Monday, 8 p. m., to March 27 in American Society of Civil Engineers Building, 220 West Fifty-seventh Street; pink ticket (these tickets read 29 West Thirty-ninth Street, but a change was necessary to secure a larger hall).

Course 3—Every Monday, 5.30 p. m., to April 3 in the Engineering Societies Building (white tickets).

Captain Dorey, U. S. A., will speak next week at each of the meetings. He will tell of the camp at Plattsburg, N. Y., of which he was in charge.

Many Attend Concrete and Road Building Conventions in Chicago

Attendance at the National Conference on Concrete Road Building in Chicago Feb. 15 to 18 passed previous records, reaching 530 on Wednesday. Engineers from the Pacific Coast, supervisors from counties with million-dollar bond issues, federal, state and municipal road officials and contractors taxed the presiding officer's parliamentary ability in their eagerness to take part in the numerous discussions.

Major Amos A. Fries' paper on permanent highways for national defense brought the latent feelings of engineers and their co-workers to the surface in no uncertain manner.

Meetings of the American Concrete Institute were well attended, 350 registering. Nathan C. Johnson's moving pictures of concrete mixing conditions crowded the hall to capacity. The officers elected by the institute are: L. C. Wason, president; H. C. Turner, vice-president; Charles R. Gow, E. D. Boyer, and J. G. Treanor, directors.

The office of the institute is to be removed to Boston and the journal is to be discontinued.

Appraisers Appointed for Chattanooga Waterworks

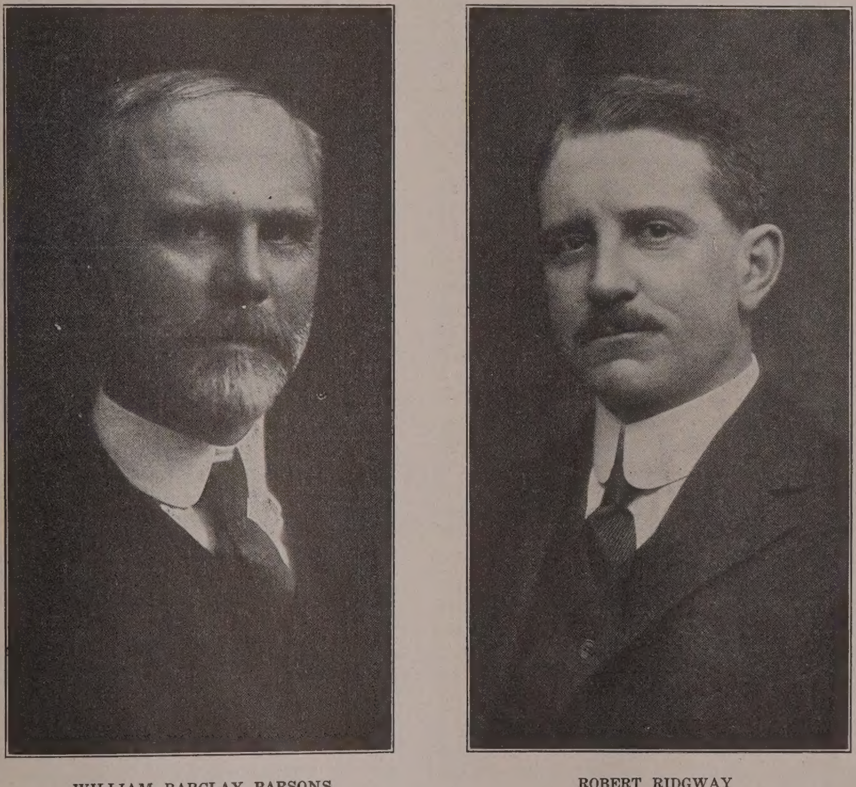
A board of appraisers was appointed Feb. 9 to investigate the purchase of the plant of the city water company of Chattanooga, Tenn., for which Chattanooga has authorized a bond issue of $2,000,000. James N. Hazlehurst, consulting municipal engineer, of Atlanta, Ga., will represent the city of Chattanooga, and William Wheeler, consulting engineer, of Boston, will represent the water company. John W. Alvord, consulting engineer, of Chicago, will be the third member of the board.

The property was offered for sale several years ago, when it was valued by the company at $1,700,000.

Engineers Begin Study of Chicago's Traction Problem

William Barclay Parsons, consulting engineer, of New York City, and Robert Ridgway, engineer of subway construction for the New York State Public Service Commission, First District, whose appointment to the traction commission to investigate the Chicago transportation problem and recommend improvements was noted in these columns last week, commenced their study, Feb. 14, in conjunction with Bion J. Arnold. Both Mr. Parsons and Mr. Ridgway have had wide experience in traction matters, and have been closely identified with the transportation development of New York City for many years.

Civil Engineers, Closely Identified with the New York City Rapid Transit Developments, Investigate Chicago's Transportation Problem



WILLIAM BARCLAY PARSONS

ROBERT RIDGWAY

William Barclay Parsons

William Barclay Parsons was born in New York City in 1859, and graduated from Columbia University in 1879. His first work was in the maintenance-of-way department of the Erie Railroad, where he attained the position of division engineer previous to his resignation in 1885. He then began a general engineering practice, engaging chiefly in the preparation of plans for underground railroads projected in New York, and in railroad and hydraulic work in different parts of the United States.

In 1891 he was appointed deputy chief engineer of the New York Rapid Transit Commission, and, in 1894, became chief engineer of the reorganized commission. In the latter capacity he prepared plans for the original New York subway, but, owing to complications in financing the work, construction was postponed. In 1898 he went to China, where he made surveys for the location of the Canton-Hankow Railroad, up to that time the longest survey made in that country. In 1899 he returned to New York City and assumed charge of the construction of the subway, continuing as chief engineer of the Rapid Transit Commission until the work was completed and opened to traffic in 1904.

During his incumbency as chief engineer such matters as the franchise providing for the construction of the Hudson & Manhattan tunnels, the Pennsylvania tunnels and terminals and the construction of the New York Connecting Railway were referred to the commission for approval. In 1903 he rendered a report on additional routes for the Manhattan traction lines and lines in the Bronx, as well as additional routes for Brooklyn and Queens, New York City, that was the basis of the comprehensive scheme of subway and elevated railroad extensions contracted for in 1913, and known as the dual system of subways now under construction. In 1902 he designed a large dam for the Hudson River Water Power Company at Spiers Falls, N. Y., and, in 1904, he served with Sir John Wolfe Barry and Sir Benjamin Baker as advisory engineers to the Royal Commission on London traffic. During the same year he was appointed by President Roosevelt a member of the Isthmian Canal Commission. In 1905 he was appointed a member of the International Advisory Board of Consulting Engineers for the Panama Canal. It was this board which decided between the different types, and adopted the plans upon which the canal was built.

He has served as consulting engineer for the Interborough Rapid Transit Company of New York City, the Hudson Companies, builders of the Hudson & Manhattan tubes, the New York, Westchester & Boston Railroad and the Susquehanna Water Power Company among other clients. At present, as consulting engineer, he represents the Interborough Rapid Transit Company in negotiations between that company and the Public Service Commission, First District. As chief engineer he had charge of the construction of the Cape Cod ship canal, which was recently completed. During the Spanish-American War he served as chief engineer of the National Guard of New York with the rank of Brigadier General.

Recently he directed the preparation of an elaborate report, just completed, on the consolidation of the public utilities, including street railroads, electric lighting, telephone and gas systems of one of the largest cities in South America.

Robert Ridgway

Robert Ridgway was born in New York City in 1862. He began engineering work in 1882 on the staff of the Northern Pacific Railroad, where he remained until 1884. In the latter year he became leveler with the Aqueduct Commission of New York City, which was created to construct new aqueducts and additional reservoirs in the Croton watershed. He attained the grade of division engineer in charge of the construction of the Jerome Park Reservoir previous to leaving that service, in 1900, to become senior assistant engineer on the construction of the present interborough subway system in New York City. In 1905 he resigned from that position to join the Board of Water Supply of New York City, on the construction of the Catskill Aqueduct, where he remained until the latter part of 1911, when he was appointed engineer of subway construction on the new dual system of subways in New York City, in which capacity he has charge of all construction work, under the chief engineer on that system.

Subsurface Land Slip Causes Building Collapse at Baltimore

A subsurface earth movement, Feb. 2, in connection with nearby dredging brought about the settlement of a large area of ground and the collapse of a stock shed of the American Agricultural Chemical Company in the Canton pier district, Baltimore. Dredging was in progress at the time in preparation for the erection of a new coal pier for the Pennsylvania Railroad.

The stock shed faces on Clinton Street, and runs back about 300 ft. to a bulkhead near the pier head line of the harbor. It is one of a group of light timber sheds, consisting of a series of open bays with about 30 ft. between rows of timber columns, which rest on concrete pedestals. The shed floor is paved with a bituminous concrete.

The level of the shed floor was about 11 ft. above mean tide. On the side where the settlement occurred, there was originally a plot of open land, several hundred feet wide, and extending from the bulkhead to the street; that is, covering the inshore end of the new coal pier site. The specifications required that the site be excavated to a 35-ft. depth in the slip at the side of the pier, it being planned to leave the excavated bank on a slope of about 1½ to 1 without bulkheading, since adjacent cuts in the local strata of sandy clay, hard sand and iron ore stood almost vertically, and other slopes within 500 ft. had stood up for years. The shoulder of the slope was fixed about 15 ft. outside the line of the chemical stock shed, which brought its toe about 75 ft. away.

The dredges had been working in the pier slip prior to the settlement, principally beyond the toe of the slope, but, shortly beforehand, one of them had been trimming the slope at a depth of about 16 ft. About three or four weeks before the collapse of the building a crack was noticed in the floor of the shed. No special significance was attached to this, since it was from 30 to 60 ft. back from the shoulder line of the dredging, and nearly 300 ft. from the harbor bulkhead. The crack widened somewhat as the work progressed, and some settlement occurred. Several shed columns were shimmed up, but it was taken to be only a small local settlement which could be adjusted after the dredging was completed.

On Feb. 2 an area of the shed floor, 60 ft. wide by about 200 ft. long, dropped to a maximum depth of 8 ft., taking the building with it. The greatest depth was on a sheer perpendicular cleavage along the line most remote from the water. The slope was thence upward to the original ground level near the outer line of the shed. A tongue of land at the original level, tapering from 15 ft. wide at its inshore end to nothing at its outshore end, remained undisturbed between the sunken area and the pier site, leaving the shoulder of the excavation practically intact except for a distance of about 50 ft. from the harbor bulkhead, where it had also sunk under water. The sunken area was thus landlocked for a distance of 150 ft. There was apparently a movement from beneath the area of the shed diagonally out toward the harbor. It is thought this was due to the gradual bleeding of a large pocket of sand, though most of the material taken out by the dredges had been noted to be clayey, with no undue amount of loose sand.

The situation will be met by driving sheet piling along the inland line of the break to check any further tendency toward movement, then bulkheading the slip after dredging, and finally filling back of the bulkhead.

News of Engineering Societies

The Chicago Engineers' Club was addressed Feb. 17 by E. J. Mehren, editor of the Engineering Record, on "Closer co-operation between national engineering societies."

The Albany Society of Civil Engineers will hear Major Edward P. O'Hearn, Ordnance Department, U. S. A., on "Modern Guns and Ammunition," at a meeting to be held at Keeler's Maiden Lane Hotel, that city, Feb. 22.

The American Institute of Consulting Engineers elected the following officers at a meeting held in New York City, Feb. 2: President, Dr. Elmer L. Corthell; vice-president, George Gibbs; secretary and treasurer, F. A. Molitor.

The Seattle Association of the American Society of Civil Engineers elected the following officers at a meeting held in that city, Jan. 31: President, A. O. Powell; vice-president, Joseph Jacobs; secretary-treasurer, Carl H. Reeves.

The Connecticut Society of Civil Engineers elected the following officers at the annual meeting held in New Haven, Feb. 8 and 9: President, Clarence Blakeslee; first vice-president, Henry R. Buck; second vice-president, P. T. Scott; secretary and treasurer, J. Frederick Jackson.

The Engineers' and Architects' Association of Southern California held a meeting at Los Angeles, Feb. 1. Major Amos R. Fries, Corps of Engineers, U. S. A., formerly in charge of work on the Los Angeles harbor, gave a talk advocating two years of compulsory military service, and the organization of the nation's resources along lines of preparedness.

The Western Society of Engineers, bridge and structural section, elected Feb. 14 the following officers for the coming year: Chairman, W. S. Lacher; vice-chairman, N. M. Stineman; directors, O. F. Dalstrom and F. G. Vent. Herbert Fisher Moore, professor of engineering materials, University of Illinois, presented a paper on "Stresses in Webs and I-Beams." Feb. 21 will be ladies' night and Judge Cutting will speak on "Washington."

The Municipal Engineers of the City of New York elected the following officers at a meeting held Jan. 26: President, Daniel L. Turner; first vice-president, William W. Brush; second vice-president, Charles E. Gregory; secretary, George A. Taber; treasurer, Herman K. Endemann. The next meeting of the society will be held Feb. 23. Francis B. Marsh, J. D. Groves and Charles E. Price will present a paper on "The New Roads Around Ashokan Reservoir."

The Engineering Society of Wisconsin will hold its annual meeting at Madison, Feb. 25-26. Papers will be read on the relation of engineers and contractors, state inspection of public utilities, flood protection, asphalt concrete pavements, surface treatment of old macadam, the water softener and its function in the treatment of boiler feed water, and sewage treatment. Among the speakers will be: T. Chalkley Hatton, A. C. Larsen, chief engineer of state railroad commission; Prof. D. W. Mead; F. G. Summons, director of public works, Milwaukee; W. F. Reichardt and James R. Valk.

The Idaho Society of Engineers, at its annual convention to be held at Burley, Feb. 21-23, will hear, among other papers: J. S. Longwell, assistant engineer U. S. Reclamation Service, on "Hydrometric Data and Practice on the Minidoka Project"; W. T. Wallace, on "Irrigation Pumping and Power Rates Therefor," and A. N. Kimmell, U. S. surveyor, on "Surveys of Overflowed Lands in Arkansas." Speakers at the banquet, to be held Feb. 22, will be Barry Dibble on "The Engineer's Opportunity to Serve His Country," E. B. Darlington on "The Success of Irrigation Projects," and J. C. Porterfield, W. H. Gibson and C. H. Mull.

Personal Notes

George W. Bacon, of the engineering firm of Ford, Bacon & Davis, New York City, has joined the export department of J. P. Morgan & Company. Although retaining his connection with the engineering firm, Mr. Bacon will devote all his time to the Morgan interests, the export department of which is engaged largely in buying supplies for the Allies.

H. A. Bayfield, who has been in charge of the Dominion government harbor work at Port Nelson, Hudson Bay, has resigned to accept a position as engineer in charge of construction for Norton Griffiths & Company, Ltd., on the harbor work at Saint John, N. B.

H. C. Brown, formerly assistant engineer in the construction department of the Illinois Central Railroad Company, has accepted a position with the Chicago Bridge & Iron Works as sales engineer, with headquarters in Chicago.

Frank P. Trott, who served as court water commissioner of Arizona for 16 years and later became a member and chairman of the state board of pardons and paroles of Arizona, was recently appointed surveyor general of Arizona by President Wilson. Mr. Trott succeeds Frank E. Ingalls, who was appointed to the office 12 years ago.

John P. Maguire, formerly superintendent of the subway department of the city of New Britain, Conn., has opened offices at 580 Arch Street, that city, to engage in business as a general engineering contractor.

L. S. Hulburd, resident engineer in charge of construction on the New York State Barge Canal at Seneca Falls, has been transferred to a similar position in Rochester, where he will have charge of some contracts for the completion of the canal which are about to be let. He will be succeeded at Seneca Falls by H. C. Smith.

D. J. Dougherty, formerly of the construction department of the maintenance-of-way department of the Pennsylvania Railroad, has been appointed a member of a party of engineers formed to work up an improved system of underground conduits to take care of all wires on a portion of the New York division. He was graduated from Pennsylvania State College in 1911.

D. A. Graham has been appointed resident engineer for the Canadian Northern Pacific Railway at Vancouver, B. C.

G. B. Swingley has been appointed supervisor of bridges and buildings for the San Antonio & Aransas Pass Railway at Yoakum, Tex.

A. C. Shields, formerly division engineer for the Chicago, Rock Island & Pacific Railway at Little Rock, Ark., has been appointed division engineer of the Missouri division, with office at Trenton, Mo.

E. H. Raquet, engineer of tests of the New York, New Haven & Hartford Railroad, has resigned to become manager of the American Wood Encysting Company, Inc., of New York City.

E. W. Davis has been appointed a division engineer in the Ohio State Highway Department.

Paul P. Whitman and L. Evans have organized the Industrial Engineering Company to engage in consulting practice, with offices in the New York Building, Seattle, Wash., and at 725 Commerce Street, Tacoma. Mr. Whitman was formerly chief engineer of the port of Seattle. Mr. Evans is an electrical engineer. The firm will give special attention to matters relating to railway and marine terminals, industrial plants, power development, and electrical and mechanical applications.

Ward Baldwin, consulting engineer, of Cincinnati, has been retained as consulting expert for the Cincinnati Rapid Transit Commission to continue the physical valuation of the properties of the Cincinnati Traction Company. The valuation is to be used by the city as a basis for readjustment of fares in the revision of the terms of the company's franchise in April.

A. C. King, deputy light commissioner of Chicago, has been retained by the city of Cincinnati to continue his survey of the properties of the Union Gas & Electric Company, of Cincinnati, preparatory to entering into a new 10-year contract for natural gas rates.

H. L. Bowman, until recently with the American Bridge Company, is now assistant to C. E. Smith, consulting engineer, Railway Exchange Building, St. Louis. Mr. Bowman is a graduate of Pennsylvania State College, class of 1911, and was with the American Bridge Company from June, 1911, until his recent change, excepting one year spent in graduate work at the Massachusetts Institute of Technology, and a half year spent as instructor in structural engineering at Purdue University.

J. G. Grossman, efficiency engineer for the Aberthaw Construction Company of Boston, is now located at Hartford, Conn., where the company is engaged on work for the Colt Patent Fire Arms Company.

Solomon-Norcross Company, consulting engineers, of Atlanta, Ga., has been retained to prepare plans and supervise the construction of a sewer system at Owensboro, Ky. It is estimated that it will require 3 months to get the plans ready and about 16 months to do the work. A bond issue of $225,000 was voted by the citizens of Owensboro last November to defray the cost of the work.

Straiton Hard, engineer and constructor, of Atlanta, Ga., will be manager of the new office the Ceresit Waterproofing Company has opened in that city. Mr. Hard is a graduate of Columbia University.

Charles E. Huber, formerly connected with the Alliance Structural Company, of Alliance Ohio, has been appointed engineering draftsman and checker for the Wellman-Seaver-Morgan Company, of Cleveland, Ohio.

Francis W. Collins, consulting engineer, of New York City, has been appointed consulting engineer of the Roanoke (Va.) Waterworks Company.

Norris E. Parratt, formerly engaged in private practice at Munising, Mich., and city engineer of that city, has been appointed engineer for the Charcoal Iron Company of America, of Detroit, at its Manistique, Mich., plant.

Charles Harding, erecting engineer of the New York Continental Jewell Filtration Company, of 15 Broad Street, New York City, has completed the construction of the filtration plant at Columbus, Ga., on which he has been engaged for the past eight months, and is located temporarily at 154 Academy Street, Jersey City, N. J.

O. F. SIEDER, for the past 3 years assistant structural engineer for the Levering & Garrigues Company, engineers and contractors on iron and steel construction, of 552 West Twenty-third Street, New York City, has been appointed chief structural engineer of that company. Mr. Sieder was graduated from Lafayette College as a civil engineer in 1902, and entered the employ of Purdy & Henderson, where he assisted in the design of such buildings as the New York Times and the Bellevue-Stratford Hotel. He then went with Westinghouse, Church, Kerr & Company, assisting in the design of the Pennsylvania Terminal Station in New York City, and many large power houses. After this service he became designing engineer in the bridge department of Milliken Brothers and represented the company in South America for several years, being located in Buenos Aires, where he built some of the first "skyscrapers" which were erected in that city. For several years after his return to this country he was assistant engineer in the bridge department of the Eastern Steel Company. He left that company to accept an offer from the Levering & Garrigues Company. One of his chief interests has been an original and practical course in structural engineering, which he has conducted for many years in the Fawcett School of Industrial Arts in Newark, N. J. This is an evening school for engineers and draftsmen. Mr. Sieder is in charge of the technical department of the institution.

C. G. ELLIOTT, consulting drainage engineer of Washington, D. C., and for ten years chief drainage engineer of the U. S. Department of Agriculture, has become affiliated with the Harman Engineering Company, of 144 Fedonia Avenue, Peoria, Ill., and the firm name has been changed to the Elliott & Harman Engineering Company. Mr. Elliott will act as consulting drainage engineer of the corporation and will have charge of the Eastern branch office in the McLachlen Building, Washington, D. C. Mr. Elliott was graduated from the University of Illinois in 1877 and has been engaged in drainage work and sanitary practice almost continuously since that time. In 1866 he was chief engineer of the Red River Valley Drainage Commission in charge of surveys and design for the drainage of almost a million acres in Minesota. From 1887 to 1889 he was in charge of drainage work in Illinois. He was appointed chief drainage engineer of the U. S. Department of Agriculture in 1903 and served in that capacity until 1913, when he resigned to engage in consulting practice in Washington, D. C. Of recent years he has had an important part in drainage developments in the State of Florida.

L. W. COINER, formerly connected with the U. S. Reclamation Service, and R. A. See, who was also connected with the Reclamation Service, have formed a partnership and have opened offices at Fort Collins, Col., to engage in practice as civil and irrigation engineers. Mr. Coiner is a graduate of the Colorado State Agricultural College and Mr. See is a graduate of the University of Missouri and Cornell University.

Obituary Notes

STEVENSON TOWLE, consulting engineer, of New York City, and formerly chief engineer of the Department of Sewers, Borough of Manhattan, New York City, died at Mamaroneck, N. Y., Feb. 14. He was graduated from Columbia University and was, for 18 years, chief engineer of the Department of Sewers. He also was, at various times, park commissioner in New York City, a member of the first Rapid Transit Commission, a member of the commission that laid out Long Island City and consulting engineer of the health and highway departments of New York City and of the Consolidated Gas Company. He was 78 years old.

DANIEL O'BRIEN, of the O'Brien Construction Company, Syracuse, N. Y., died Feb. 6. He was formerly the head of the contracting firm of O'Brien & Hoolihan, which constructed numerous buildings at the Brooklyn and Portsmouth, N. H., navy yards, and later had contracts on the New York State Barge Canal.

DAVID BROWER, who retired June 1, 1915, after 54 years of continuous service on the engineering force of the sewer department of the Borough of Brooklyn, New York City, died Feb. 14. An outline of Mr. Brower's professional activities was published on page 788 of the June 19, 1915, issue of this journal.

CHARLES BECK, a civil engineer, of Ashland, Pa., died recently. He was forty-seven years old.

MICHAEL J. MACK, civil engineer and surveyor, of New York City, died Jan. 23. In 1872 he was on the first survey of the West Shore Railroad, as transitman and chief of corps, in the Mohawk Valley, from Utica to Fink's Basin, and from Victor to the Genesee River. From 1873 to 1875 he was U. S. assistant engineer on the surveys and plans for the improvement of the Chattahoochee and Apalachicola rivers from Alabama to Florida, a distance of 350 miles. Also he was on the survey for the improvement of the Ouachita River for a distance of 300 miles, and for the improvement of the Cahaba River for a distance of 100 miles. From the latter year until 1878 he was engaged in private practice in New York City and vicinity. In 1878 he was appointed U. S. assistant engineer in charge of surveys and plans for improving the mouth of the Red River in Louisiana. He went from this work to become assistant engineer and chief engineer of the Belleville & Eldorado Railroad. Following this work he prepared the first sewerage plan for Topeka, Kan., and was, for a time, in the office of the Atchison, Topeka & Sante Fé Railroad, and U. S. deputy mineral surveyor for New Mexico. From 1890 he was in Costa Rica on railroad work. From 1891 to 1892 he was engaged in the construction of waterworks in Southern cities, and, from 1893 to 1909. he was engaged in municipal work in New York City.

THOMAS J. MOORE, general manager of the Philadelphia branch of the Holcomb Steel Company, died recently at Atlantic City, N. J.

SIR CHARLES R. WILSON, a former president of the Grand Trunk Railway of Canada, died in England, Feb. 9.

GEORGE W. SWINBURNE, civil and mining engineer, died in East Orange, N. J., Feb. 3. He was graduated from Lafayette College in 1883 and, during his engineering career, was connected with the New York City Croton Aqueduct, with George E. Waring on sewage and water supply work among other works, previous to entering private practice in New York City as a member of the firm of Swinburne & Clarke, civil engineers. At the time of his death he was connected with the Sterilization Company of Newark.

JONATHAN B. HARRIS, a railroad contractor of international reputation, died at his home in Monrovia, Cal., Feb. 9, at the age of 81. In California Mr. Harris built the Central Pacific and the Southern Pacific lines, from Bakersfield south to the Colorado River, including the Tehachepi Pass, with its 17 tunnels and 14 miles of track. In the Northwest he built lines for the Northern Pacific and the California & Oregon and on the island of Cuba he constructed an important railroad for which he received a substantial reward from the government. One of his most picturesque exploits as a contractor was the construction of a line in Guatemala for the Southern Pacific. Here he used native labor exclusively, and was handicapped by governmental regulations, but completed the job 7 months ahead of the time set by a lapsing franchise, and with a saving of approximately $300,000 for the company out of its appropriation.

EDGAR M. JESSUP, engineer maintenance-of-way of the San Pedro, Los Angeles & Salt Lake Railway, at Los Angeles, Cal., died Feb. 9 at the age of 57. Mr. Jessup spent almost his entire life in the service of the San Pedro, Los Angeles & Salt Lake and its predecessor, the Los Angeles Terminal Railway. Entering the employ of the latter 30 years ago, he assisted in surveying and constructing its main line between Los Angeles and Pasadena. When the road was absorbed in 1901 by the newly organized San Pedro, Los Angeles & Salt Lake, he was made engineer maintenance-of-way, which position he held until his death. He was born in Iowa and spent his early life as a surveyor there.

FREDERICK W. CLARK, a retired builder and contractor, died in Chicago, Feb. 5 at the age of fifty-nine. He was graduated from the Massachusetts Institute of Technology in 1880, and for ten years followed the profession of mining engineer. Then, for six years, he was assistant professor of mining engineering and metallurgy at his alma mater. In 1889 he entered the building and contracting business in Chicago, and, from 1902 to 1909 was president of the Clark Construction Company.

GEORGE A. HANCOCK, a well known railroad constructor, died Feb. 9 in Los Angeles. Mr. Hancock was perhaps best known among railroad men as the builder of the Atchison, Topeka & Santa Fé shops at Topeka, Kan., and the St. Louis & San Francisco shops at Springfield, Mo. He was formerly general superintendent of motive power of the St. Louis & San Francisco Railway, and also assistant superintendent of machinery of the Atchison, Topeka & Santa Fé. He was born in 1856 in Toronto, Can., and as a young man worked for the Grand Trunk in various capacities. In 1881 he went to Albuquerque, N. M., and worked as a machinist for the Atchison, Topeka & Santa Fé, and in a few months was made shop foreman at El Paso, Tex., where he remained four years, rising to the position of master mechanic. It is said that while he was in El Paso Mr. Hancock coupled up the first engine for service on the Mexican Central and also was on the first engine that ran under steam from the United States into Mexico. He had been connected for about a year with the Southern California Railroad at San Diego, Cal., when, in 1885, he was made assistant superintendent of machinery of the Atchison, Topeka & Santa Fé, with headquarters at Topeka, a position he resigned two years later to become general master mechanic of the Atlantic & Pacific with headquarters at Albuquerque. He remained with this road and its successor, the Atchison, Topeka & Santa Fé, or its subsidiary, the Gulf, Colorado & Santa Fé, until March, 1901, when he was made superintendent of motive power of the St. Louis & San Francisco, and a few years later, general superintendent of motive power. Failing health forced him to resign in 1914, and he traveled a year before taking up his residence in Los Angeles.

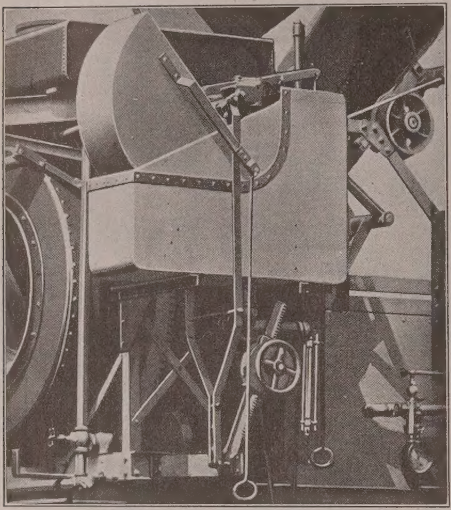
Civil Service Examination

United States.—An open competitive examination for an aid, qualified in engineering, is to be held March 8 at the usual cities throughout the country where service boards are located. The position is in connection with the Bureau of Standards in Pittsburgh at a salary of $840 a year, or with other branches of the bureau at a salary of from $600 to $840. Those who take the examination must have a thorough understanding of mathematics, through trigonometry and physics and mechanics. Experience in laboratory work or one or more years of an engineering course in a university or a college will be given special consideration. Application form 1312, specifying the title of the examination, may be obtained from the Civil Service Commission, at Washington, D. C., or from any of the civil service boards.

High Drum Setting and Water Weigher Improve Paver

By setting the mixer drum, on the upper part of the frame work of the machine, 9 ft. above the ground, the swivel spout on the latest type of Smith-Chicago paver exhibited for the first time at the Cement Show, Chicago, makes an angle not less than 20 deg. with the horizontal.

In spite of the high position of the drum the designers have kept the center of gravity within a few inches of the position in the older charging types. This is done by bunching the traction and hoisting machinery over the rear axle on a one-piece casting supported by a heavy cast-steel bolster independent of the truck sills.

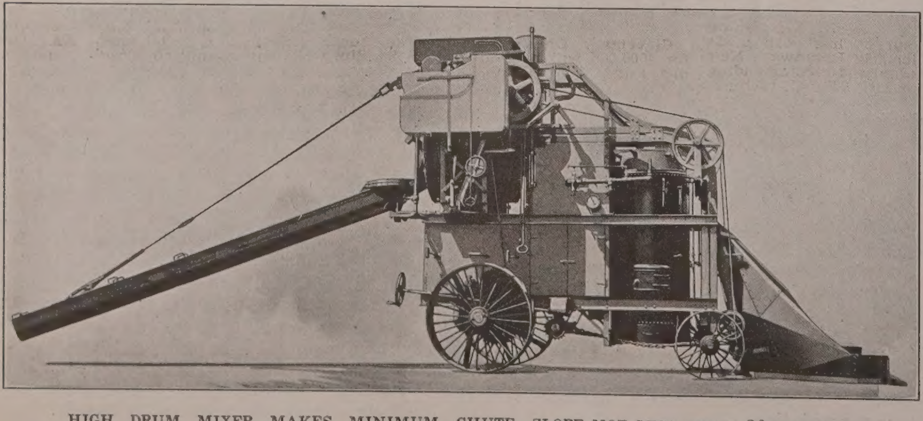


AUTOMATIC WATER WEIGHER DISCHARGING

In the new machines it is claimed that added power has been put into the engine so that the skip may be unloaded in eight seconds. Discharge takes place in twelve seconds. The skip on the large machine is sufficiently wide to permit three men to empty their barrows simultaneously.

A positive and automatic water feed easily changed becomes essential on this machine since the height above ground precludes a personal inspection without difficulty. The photograph shows this device in the tipping position. The semi-cylindrical tank is supported on a pivot and balanced by a weight adjusted to the weight of water desired. When the tank is empty the weight sinks and raises the tank about 3 in. A lug inside the tank engages a spindle of the valve controlling the water supply from the storage tank holding water for five batches. When sufficient water has passed into the measuring tank the weight is overcome and the tank settles down, closing off the supply automatically. When the skip is hoisted the tank is tilted through a train of levers which are engaged by the front roller. The water then flows into the tank surrounding the measuring tank, passing in through the feed pipes to the mixer drum at the same time that the dry materials enter and mingling with them before the batch reaches the bottom of the drum. The amount of water can be accurately adjusted by moving the weight along the graduated lever on which there is a rack to hold it in any fixed position.

The high drum type of paver is made in 4, 7, 10 and 16-cu. ft. sizes, wet measure, by the T. L. Smith Company, Milwaukee.



HIGH DRUM MIXER MAKES MINIMUM CHUTE SLOPE NOT LESS THAN 20 DEGREES

Steel and Iron Plants on the Pacific Coast Add Extensions

The Pacific Coast Steel Company on Jan. 25 awarded contracts for two new 60-ton open hearth furnaces which will be installed immediately as additions to the South San Francisco plant of this company. This addition to the equipment will raise the capacity of this plant from 200 tons to 500 tons of finished product per day. With the new furnace a 36-in. blooming mill will be installed and the limiting size of structural shapes which can be handled will be increased to 15-in. I-beams.

Simultaneously with the San Francisco plant increase, the Seattle mills will receive an additional 60-ton furnace which will increase the capacity at that point to 11,000 tons per month. The raw product which this company uses is brought from red hematite mines in China under long term contracts. The fuel used in the mills is California petroleum.

The plant of the United Engineering Works of Alameda, Cal., was purchased on Jan. 26 by the Union Iron Works of San Francisco, which company plans, it is announced, to remodel the plant and equip it for shipbuilding work. The transfer involved about $1,000,000, it is reported, and the remodeling is to cost $250,000.

Oil Pressure Pump Designed for Electrical Machinery

A motor-drive pump designed especially for forcing oil under the bearings of electrical machinery has recently been placed on the market by the Goulds Manufacturing Company, pump builders, Seneca Falls, N. Y.

This pump, which is known as Goulds Fig. 1673 is of the single-acting, quadruplex, horizontal type with ⅞-in. cylinders and stroke of 4 in. It is designed for a capacity of 2 gal. per minute against a pressure of 1200 lb. The base of the pump is built with a self contained reservoir of 10-gal. capacity, to which the oil returns from the bearings.

Business Notes

The Lenher Engineering Company, sales agents for the S. Flory Manufacturing Company, manufacturer of hoists and cableways, has moved its offices to 95 Liberty Street, New York City.

The Pacific Coast Steel Company has moved its Seattle sales office to 915 Alaska Building in the same city.

National Paving Brick Manufacturers' Association will hold a meeting at Hotel Statler, Cleveland, Feb. 21-22. Will P. Blair, Brotherhood of Locomotive Engineering Building, Cleveland, is secretary of the association.

S. E. Elmore, formerly Central sales manager of the Bucyrus Company, manufacturer of steam, oil and electric shovels, hydraulic machinery, drag line excavators and railway cranes, of South Milwaukee, Wis., has been appointed superintendent of the company's Evansville plant. E. C. Hingston will succeed him at Chicago as Central sales manager, and G. H. Hutchinson will be Western sales manager, having his office at the Merchants' National Bank Building, San Francisco.

Trade Publications

The following companies have recently issued trade literature:

Rogers Brothers Company, Albion, Pa., catalog A, 16 pages, steel two-wheeled auto trailers.

Pioneer Asphalt Company, Lawrenceville, Ill., circular, 8 pages, road asphalt and surface asphalt.

M. Smolensky Manufacturing Company, 932 Garfield Building, Cleveland, Ohio, catalog, 16 pages, suction and check valves, price list.

Trussed Concrete Steel Company, Youngstown, Ohio, catalog, 32 pages, Kahn portable steel houses; garages, contractors' offices, etc.

McClintic-Marshall Company, Pittsburgh, portfolio, 48 pages, photographic reproductions of steel building, bridges, etc., furnished and erected by this company.

American Cement Machine Company, Inc., Keokuk, Iowa, circular, 16 pages, Boss concrete mixers, road pavers and mortar mixers of 5-ft., 7½-ft., 10-ft. and 15-ft. capacities.

Expanded Metal Engineering Company, 101 Park Ave., New York, booklet, 12 pages, new building ordinance of New York City, and use of steelcrete mesh for floor and wall construction.

Warren Brothers Company, 142 Berkeley Street, Boston, Mass. Catalog, 11 x 8½ in., 30 pages, illustrated. Narrates the history of Warren's portable asphalt plant, its experimental stages and their results, and describes the particular fitness of this machine for asphalt paving mixing, as to its construction, operation and maintenance expenses. It is typographically well compiled and is logically arranged in the way it treats the evolution of the Warren plant.

E. I. du Pont de Nemours Powder Company, Wilmington, Del. Booklet, 6 x 9 in., 128 pages, illustrated; entitled, "Road Construction and Maintenance." While the object of this publication is doubtless to promote the use of explosives in road building it does not restrict itself to this phase of the subject only, but rather goes in great detail into the general subject of road construction and maintenance. The way in which the text is classified is sufficient to indicate the general nature of the book. For instance, it commences with location and construction of roads, goes on to clearing of rights-of-way, then, discusses road drainage and deprecates the practice of making heavy grades, instructing in the means for their reduction. From here the book takes up the subject of subgrades and surfaces, explaining in detail the various practices of road construction and enumerates various methods of upkeep of country roads. Closing it describes equipment, such as scrapers, drags, rollers, graders, etc., and finally comes into its own by a general description of explosives and blasting supplies. Appended is a glossary of road building terms, as well as some valuable advice on handling of explosives. The book, which is in reality a text book, will be sent to whosoever applies for it, provided this journal is mentioned.